MEAT RESEARCH

NEWSLETTER

1974-77

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Meat Research News Letter

CSIRO Division of Food Research
Meat Research Laboratory

Enquiries on technical matters relating to the meat industry should be sent to the Laboratory's Information Officer.

P.O. BOX 12, CANNON HILL, BRISBANE, QLD. 4170.
(CNR. CREEK AND WYNNUM ROADS).
TELEPHONE 95 2122. TELEGRAMS FOOD RESEARCH BRISBANE.

Date 6th May, 1974 **Number** 74/3

BLOOD

During the last three years shortages and sharp rises in price have stimulated interest in a number of unusual sources of protein for human consumption. One potentially valuable source is blood from abattoirs. Large quantities are available and the proteins in it are of the highest value nutritionally.

Blood is an opaque fluid, red in colour when oxygenated and purplish when not oxygenated. It comprises a yellowish fluid called plasma in which are suspended red, and white blood cells, and smaller bodies termed platelets. The oxygen-transporting protein (haemoglobin) of red blood cells gives blood its characteristic colour.

The amount of raw blood recoverable by bleeding livestock varies but is of the order of 3.5% of the live weight for cattle, and somewhat less for other species.

PLASMA:

Plasma is that part of the blood remaining after the removal of the cells from unclotted blood. It is a clear, yellowish fluid and accounts for some two-thirds of the total wet weight of whole blood. The composition of blood and plasma are approximately as follows :

Component (%)	WHOLE BLOOD			PLASMA		
	Beef	Pig	Sheep	Beef	Pig	Sheep
Water	80	78	82	91	91	92
Haemoglobin protein	11	14	10	-	-	-
Other protein	7	6	6	7	7	6
Non-protein solids	2	2	2	2	2	2

The most abundant protein in plasma is albumin. The next major protein is globulin and a third is fibrinogen which plays an important part in the process of blood clotting.

SERUM:

Blood rapidly clots after removal from the animal because of the conversion of fibrinogen into threads of insoluble fibrin. If the blood is held in a container the clot will shrink after a few hours, expressing a clear fluid known as serum. Anti-coagulants prevent blood clotting.

Mechanical action will also convert fibrinogen in raw blood to threads of fibrin which can then readily be screened out to leave clear serum.

CONVENTIONAL METHOD OF BLOOD COLLECTION.

The blood from a stuck animal is usually run into a floor drain together with some wash water. The blood proteins are later steam coagulated and then a considerable part of the water content is separated by mechanical means. The coagulated blood is finally heat dried. The method may either be a continuous or batch process.

The process yields a red-black powder which is suitable only for animal feed or fertilizer.

COLLECTION OF BLOOD FOR EDIBLE PURPOSES:

Blood, saved for edible purposes, must be collected without contamination. Both carcase and blood are kept identified until carcase inspection is complete since blood from condemned carcases cannot be used for edible purposes.

Blood has been collected for many years in Europe, generally for the production of specialty smallgoods such as blood sausage. All satisfactory blood collection techniques require that the stick wound area be prepared in such a manner that contamination of the blood is avoided. In pigs this is done by applying a gas torch and shaving; in cattle, a portion of the hide is grasped by hand and removed, by a single stroke with a sterile knife, thus exposing an area of tissue having minimal contamination. A hollow-bladed sticking knife is then inserted, severing the blood vessels. The blood is conveyed through tubing to a holding tank. It is generally batched either on the basis of animal numbers or elapsed time. All blood batches must be held until the animals, from which the blood has been collected, have been passed as fit for human consumption. If any carcase is condemned then the entire batch of blood is diverted for processing into animal feed and the entire line from knife to batch holding tank must be cleaned and sanitized. A sticking knife used for blood recovery is shown in Figure 1.

Clotting of the blood can be prevented by the addition of a solution of sodium citrate in water. The United States Department of Agriculture, Animal and Plant Health Inspection Service permits the addition of sodium citrate (or citric acid) in amounts up to 0.2% of blood weight using a solution containing no more than 66% water. The anticoagulant is usually applied at a point close to the sticking knife. Figure 1 shows the valve, which controls the anticoagulant flow, mounted on the hand piece of the knife.

At high kill rates vacuum equipment is generally used to speed up bleeding. However, one system developed in Europe extends the time available at the blood recovery point to permit bleeding by the usual heart action and gravity. The animals are transferred after stunning to a suspension rail on which they travel in a semi-circle around the blood collection point ("Carousel"). On completion of bleeding they are transferred to a standard dressing rail system.

PROCESSING OF EDIBLE BLOOD:

There is an increasing interest in Europe in upgrading blood processing to extend the use of blood fractions. The traditional method is to separate the plasma and blood cells by centrifugation. The plasma is either frozen in flakes on a

roller drum or frozen in blocks, and used in smallgoods products. It can also be used as a substitute for egg albumen in other prepared foods. Because of its intense red colour the haemoglobin is generally dried and limited to use for feeding animals although some is used in blood sausage-type commodities. Conventional spray or roller drying techniques are used.

A recent Swedish development in low temperature drying equipment now permits the plasma and, if required the haemoglobin, to be dried, simply and effectively. The temperatures used ensure minimal degradation of the product and the low moisture content of the final product allows the plasma to be conveniently stored and distributed.

The disadvantage of treating plasma separate to haemoglobin for use as a food additive is that the haemoglobin fraction, amounting to 60% to 70% of the total protein in blood, has to be rejected as a lower grade byproduct.

SIROGLOBEIN PROCESS:

CSIRO has developed the Siroglobein process whereby whole blood is simultaneously precipitated and decolourized with a mixture of acetone and hydrochloric acid. A colourless, odourless, bland edible protein powder which has been named "Globein" is recovered after filtration, washing with acetone, and solvent removal. "Globein" has a protein value similar to high grade beef, lamb, or pork.

The Siroglobein process requires special technology and the economics of scale in the process would almost certainly mean that it would be uneconomical for the average meat works to construct a processing plant for treating blood by this method. It is possible that some larger meat works with daily beef kills of 1,000 or more, may find it profitable to invest the capital but a central processing facility treating the blood from a number of works in a given area is more likely.

The method is currently being used on an experimental scale in CSIRO laboratories and the process is covered by a CSIRO patent. CSIRO is anxious to cooperate with the industry in developing this method to full scale viability. To this end, tenders are being invited to undertake development under the general direction of CSIRO in accordance with the terms outlined in the copy of the tender advertisement enclosed.

CONCLUSION:

With the ever-increasing world shortage of food proteins and increase in their economic value, it would appear that works should have a close look at the collection and processing of edible blood.

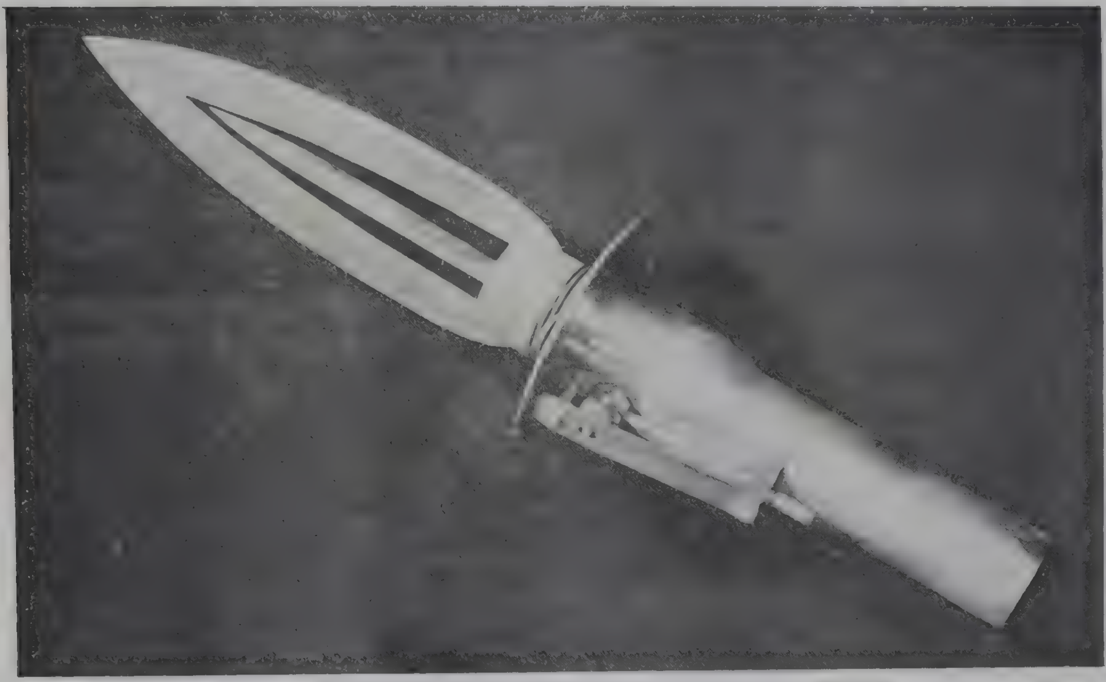

FIG. 1: Detail of sticking knife used for blood recovery.

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Date 1st July, 1974 **Number** 74/4

GUIDELINES FOR ESTIMATING YIELDS FROM RENDERING OPERATIONS

It is important for abattoir managers to have information on the comparative returns to be derived from disposing of certain offals as pet food or dry rendering them to get tallow and meat meal. Some difficulty may be expected in obtaining information on the latter. However, given raw material analyses in terms of fat, water, protein and if possible ash, the theoretical meat meal and tallow yields from the dry rendering operation may be calculated together with the protein content of the meal. The calculated values agree fairly well with those obtained in practice.

Further, if batches of mixed raw materials (as are normally used) are rendered calculations can be made to give a fair indication of the practical yields provided the proportions of offals in the mix are known.

In making calculations from basic analytical data it is vitally important that the offals should be precisely specified in terms of the degree of trimming and amount of residual water from any washing that has taken place. Different abattoirs use different fat trimming and washing procedures. Such differences in preparation can have a considerable effect on the meal and tallow yields obtained. For example, commercial trials on

rendering offals with the same description from three different abattoirs gave the results shown by the following figures which adequately demonstrate the effect of differences in preparation on meal and tallow yields.

	Abattoir	Tallow Yield	Meal Yield
Boning room bones (beef)	A	15.9%	54.2%
	B	19.4%	58.3%
Boning room fats (beef)	A	58.1%	13.4%
	B	64.4%	11.2%
	C	67.9%	9.4%
Unwashed intestines	A	19.0%	13.9%
	B	15.5%	13.6%

A large part of these differences is due to the different initial water content of the offals.

In the Table appended to this News Letter figures have been calculated on the assumption that offals are trimmed fairly clean of fat, and bones are trimmed fairly clean of meat. In the case of bones the protein content of the meat meal is profoundly affected by the amount of residual meat. It has also been assumed that the water from any washing procedure is thoroughly drained away. Therefore, the figures represent base line values which must be modified for different methods of offal preparation. Each operator can easily do this by using the method outlined below, if the analysis of the particular raw material is available. In addition to the variations within the offal types there are likely to be small operational differences in the rendering procedures, particularly in the pressing operation, which will also affect the meal and tallow yields.

In any practical rendering operation tallow and meal yields and the protein content of the meal will vary over a range due to the above factors. Hence, the figures are expressed as a range in which most practical rendering yields might be expected to fall. It is meaningless to express these figures more precisely.

It is unlikely that the fat and water content of the meal could be controlled and for comparative purposes the theoretical yield figures in the tables are calculated to a 6% water and a 9% fat basis. Calculations based on different fat and water

contents are simple to make. Also included in the tables are a number of values that were obtained experimentally and these are quoted with the fat and water contents actually obtained and have not been calculated back to the 6% water and 9% fat level.

As an example of the method of calculating yields let us consider beef tongue roots.

Raw analysis of beef tongue roots :

Protein	16%
Fat	15%
Water	68%
Ash	0.9%
	99.9%

Assume final meal to contain 6% water and 9% fat.

Then weight of final meal from 999 lb of raw material

= 160 lb of protein
9 lb of ash
+ fat
+ water

Let x = final weight of meal, then amount of fat in meal is $\frac{9}{100}x$ lb and amount of water is $\frac{6}{100}x$ lb

$$\therefore \text{ meal weight } x = 160 + 9 + \frac{9}{100}x + \frac{6}{100}x$$

$$x = 169 + \frac{15}{100}x$$

$$x = 198$$

$\therefore$ final meal yield = 198 lb = 19.8%

Fat in final meal = $\frac{9}{100}x = \frac{9 \times 198}{100}$ = 17.8 lb

Fat originally present 150 lb

$\therefore$ tallow yield = 150 - 17.8 = 132.2 lb or 13.2%

Protein content of meal = $\frac{160}{198}$ = 80.5%

It will be noticed that the raw analyses quoted for beef tongue roots do not add up to 100% exactly. This is because there are some experimental errors involved in the analyses and in practice the total percentage will usually add up to be in the range 98-102%.

From the table it will be noted that there is little species difference between various types of soft offals and it seems likely that there is as much variation between different batches of the same offals from one species of animal as there is between batches of the same offal from different species. However, this is not the case with bones. In the first place, the protein content of green bones can vary from 18-24% depending on the part of the skeleton from which they originate. Secondly, although the actual percentage of protein does not appear to change with the age of the animal the ash content of the bones increases with age (water simultaneously decreasing) and consequently the meal prepared from the bones of old animals would contain a lower percentage of protein - this is clearly shown from the figures in the table. Age does not have any appreciable effect when soft offals are being considered.

Protein (nitrogen), fat, and water analyses are simple and straight forward to carry out on soft offal. The most important requirement when carrying out an analysis of the raw material is to obtain a representative sample and the larger the sample that can be minced up for ultimate analysis the more meaningful the figures are. Most abattoirs are already equipped to perform fat analyses and a water-content determination simply requires an accurate balance and an oven. Protein analyses are slightly more complex but, if the fat and water contents of the raw offal are known, and if the protein content is assumed to be the difference approximate figures for tallow and meal yields can be calculated. If this is done the calculated protein content of the final meal is always 5-8% too high due to the small amount of ash not considered and an adjustment should be made. An alternative method is to estimate the ash content of the raw materials from the examples in the table. These procedures are applicable only to soft offals and cannot be accurately applied to bones because of their high and variable ash content.

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CONFERENCE

ADVANCES IN MEAT SCIENCE AND TECHNOLOGY

I. MEAT CHILLING AND HANDLING

It is proposed to hold a series of conferences, staged every two or three years, on the general subject of Advances in Meat Science and Technology. The first of these is an industry-orientated conference on meat chilling and handling to be held in

BRISBANE ON 13 AND 14TH NOVEMBER, 1974.

Further details and registration forms will be distributed with the next Newsletter. Meanwhile, we suggest that you make a note of the date.

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MEAL AND TALLOW YIELDS FROM VARIOUS OFFALS

SHEEP AND PIG

OFFAL	RAW MATERIAL ANALYSIS % WATER	% PROTEIN	% FAT	% ASH	YIELDS % MEAL	% TALLOW	% PROTEIN IN MEAL	COMMENTS
SHEEP:								
Liver	71	21	4	4.3	28-30	1-2	69-71	Calculated values 6% water, 9% fat in meal
Lung	79	18	2	1.1	21-23	Nil	79-81	
Spleen	75	19	4	1.6	23-25	1-2	77-79	
Tongue roots	70	14	15	1.0	16-18	12-14	78-80	
Bones (entire skeleton) (mutton)	48	18	24	10.0	31-33	20-22	53-55	
Skulls	Not available				36-44	11-13	N.A.	Commercial data
Tripe	Not available				11-13	1-2	77-79	Experimental (meal 6% water, 9.7% fat)
Rumen	80-85	13-15	2-3	0.5-1.0	16-18	0.5-1.5	79-81	Calculated values 6% fat, 9% tallow in meal
Abomasum	70-79	6-10	16-18	-	8-10	15-17	84-86	
PIG:								
Liver	72	20	5	3.2	26-28	2-3	72-74	Calculated values 6% fat, 9% tallow in meal
Lung	84	13	2	0.8	15-17	Nil	79-81	
Spleen	77	17	4	1.0	20-22	1-3	79-81	
Tongue roots	66	17	16	1.9	21-23	13-15	75-77	
BEEF								
Liver	70	20	4	6.8	30-32	Nil	62-64	Experimental values calculated to 6% water and 9% fat in meal
Lung	79	18	2	1.0	21-23	Nil	79-81	
Spleen	76	19	4	1.5	22-24	Nil	77-79	
Tongue roots	68	16	15	0.9	19-21	12-14	79-81	
Trachea	Not available				21-24	22-24	80-82	
Omasum (Bible)	Not available				14-15	3-4	66-73	Experimental value (meal 3% water, 6% fat)
Oesophagus	Not available				25-27	1-2	64-67	Fat and water in meal not known. Experimental
Intestines	Not available				6-8	10-11	73-76	Experimental (meal 6% fat, 3% water)
Abomasum	68-75	7-8	22-26	-	8-10	22-24	84-86	Calculated (meal 6% water 9% fat)
Entire digestive tract (likely average value)	72	15	11	2.5	19-21	8-10	71-73	"
Rumen	78-84	14-18	2-4	0.7-1.0	18-20	0.5-1.5	79-81	"
Paunch (reticulum and rumen)	Not available				12-13	9-10	66-68	Experimental (fat and water in meal not known)
Bone - 3 mth steer	46	20	14	20.5	46-48	8-10	40-42	Calculated values (6% water, 9% fat in meal)
Bone - 48 mth steer	32	21	21	26.5	54-56	15-17	36-38	
Bone skeleton of foot (48 mth)	44	22	14	20.1	48-50	8-10	43-45	
Bone skeleton of head (48 mth)	55	18	7	20.2	44-46	1-3	39-41	
Average all bones	38	19	21	22.1	47-49	15-17	38-40	
Ox skulls	Not available				40-50	6-10	N.A.	From commercial data

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Date 26th August, 1974 **Number** 74/5

STUNNING CATTLE

INTRODUCTION:

Slaughtering establishments are required to slaughter all stock in a humane manner approved by the Australian Department of Agriculture. For cattle this is done almost exclusively by using captive-bolt stunners, which may be of either the non-penetrating or penetrating type, before the animals are bled.

Over a period of time claims have been made by the industry that the stunners in general use are not satisfactory for all classes of cattle. A survey indicated that the problem was due largely to an inability to stun some animals effectively with one blow. This was most pronounced when handling large oxen and bulls.

Examination of the stunning procedure shows that effective stunning is influenced by many factors only two of these being the actual type and power of the stunner.

SITE:

It is the general practice to stun cattle by applying an impactive force at one of two sites, the front of the skull and the back of the head at the base of the skull. The aim is to render the animal unconscious, death being brought about by subsequent bleeding. It is therefore essential that with any technique the normal heart function is maintained.

Figures 1 and 2 indicate the generally accepted method of locating the area of impact in frontal stunning. This area is determined by drawing imaginary lines between the base of each ear and the opposite eye. The point at which the lines intersect is within a zone in which the bone of the skull has minimum thickness and therefore minimum strength. However, as the bone structure of the skull rapidly increases in thickness around this zone any deviation at impact, could result in inadequate stunning.

FIG. 1: STUNNING SITES:

(A) Frontal; (B) Base of Skull; (C) Pithing.

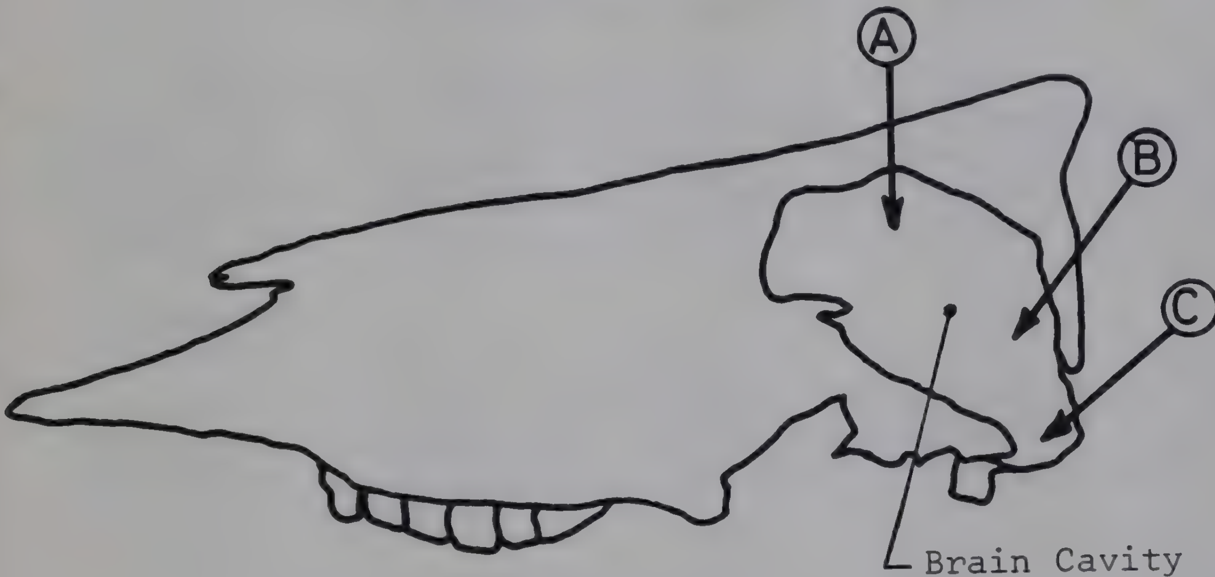
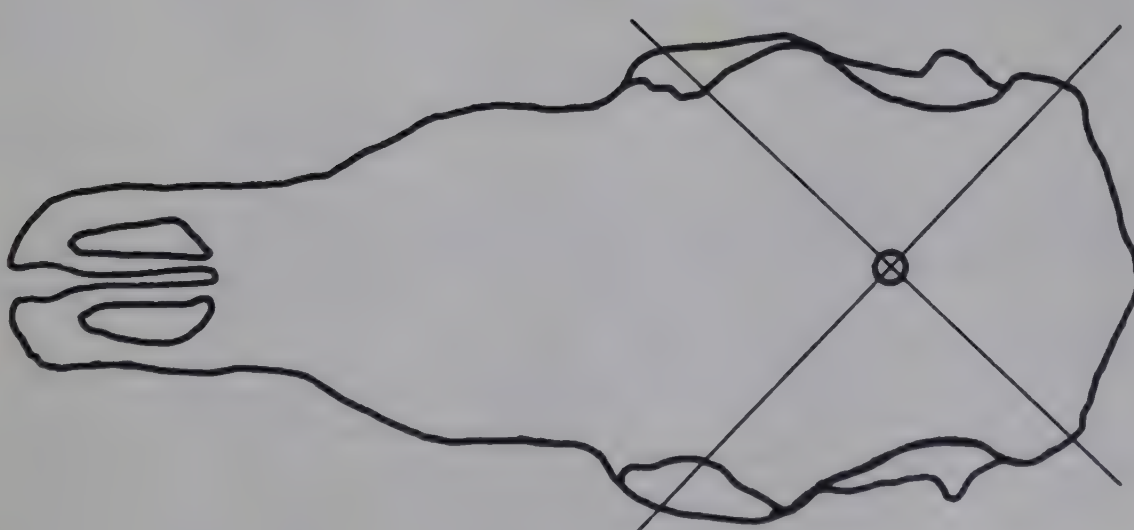


FIG. 2: FRONTAL STUNNING:



Stunning can be achieved through the frontal area by both non-penetrating and penetrating type stunners. These impair the brain function by the sudden application of forces and render the animal unconscious. Non-penetrating stunners permit the recovery of brains, intact, for further processing and marketing. However the application of too much force can fragment the bone structure and drive bone fragments into the brain tissue.

With the penetrating type stunners the bolt can be applied in the same zone. However the bolt bruises the brain and having been driven through the hide and bone structure can contaminate it. This prevents maximum recovery of brains for edible purposes and results in a financial loss to the industry.

Stunning by striking the back of the head at the base of the skull (Fig. 1) can be achieved only by penetrating stunners. This method minimises brain damage but as the penetrating bolt must pass through neck muscle to reach the brain cavity all haemorrhagic tissue must be trimmed from the carcase.

ECCHYMOSIS:

Ecchymosis, or blood splash, is an escape of red blood cells from blood vessels into the surrounding muscle. In fresh meat the haemorrhages appear as dark red spots usually not more than ½" in diameter.

To minimise ecchymosis it is important that animals be stunned while they are in a rested and unexcited state and bleeding should be carried out as soon as possible after stunning. Effective pithing as shown in Figure 1 (i.e. complete cutting of the spinal cord at the atlanto-occipital joint immediately after stunning) reduces this disorder to a very low incidence.

RESTRAINING THE ANIMAL:

From the previous section it is obvious that if an animal is lively and unrestrained it becomes difficult to apply the necessary stunning force at the very small target area.

It is usual in Australian abattoirs to use a knocking box of fixed dimensions to restrain all animals ranging from yearlings to aged oxen and bulls. The box is also designed to accommodate horned animals. It is fair to say that usually the only animals adequately restrained are large size bulls. Some knocking boxes are so large that several yearlings can be accommodated simultaneously.

OPERATOR:

A comfortable and safe stunning position is essential for the operator. Ideally the impact site on the animal should be presented to the operator at a convenient height which is related to the animal size, the type of stunner used and the height of the work platform. The need for extreme stretching and twisting by the operator should be reduced to a minimum.

STUNNER:

This must be simple, quick in action and require the minimum amount of physical effort to operate. It should be safe in operation and provided with a manual safety catch. The impactive force should be applied automatically on contact with the animal. Sufficient force must be applied to adequately stun all animals being processed. The stunner should also be of robust construction and have a minimum number of moving parts.

The stunners used in the industry can also be classified by the means by which the high impactive force is produced. These are :

1) Pneumatic - the impactive force can be varied in these units by varying the air pressure. Due to the principle of operation, i.e. a ram moving some distance along a cylinder, the unit is basically a long tube. It has an extended tubular hand-piece. With the normal operator's position being behind the head, the design of the pneumatic stunner restricts its use to stunning at the base of the skull with a penetrating bolt. When the unit is provided with an efficient counterweight hanging system it requires minimum effort by the operator. Reloading is automatic and the stunner is complete with a manual safety lock. The impulsive force is triggered by contact with the animal.

   It is claimed by the manufacturers that operating costs for this type of stunner are minimal since even at high kill rates a single air compressor powered by a 2 HP motor is adequate. However, failure of the stunner due to mechanical failures can be a problem and in practice most plants operating this type of stunner generally work with three units - one in use, one as standby and one being overhauled. This requires a much larger capital investment. In trials it was also noted that where the manufacturers' recommendations were followed the air accumulator capacity proved to be inadequate, resulting in a rapid drop in air pressure and consequent variations in stunning performance.

A common type in use is the "Thor Pneumatic Stunner". This is a penetrating-bolt type powered by medium pressure air over a pressure range of 965-1380 kPa (140-200 psi). The manufacturers recommendation is to vary the pressure setting in proportion to animal live weight. This is impractical as it takes time to achieve the re-set pressure conditions. For this reason it would appear to be the common practice to operate at one pressure setting continuously, this pressure being selected to suit the most common heavier animals, which are steers requiring a pressure of 1100-1200 kPa (160-175 psi). As a result when larger animals than these are being processed the impactive force is insufficient for effective stunning at one blow.

The "Thor" stunners examined were effective on all animals other than aged oxen and large bulls. The long tubular form of the stunner assisted stunning as the stunning site could be reached in most animals irrespective of the position they took up in the knocking box.

It is claimed by one abattoir, that the total stunning cost per head processed is 2.38 cents. This figure includes capital charges, air compressor power costs, maintenance and replacement items.

Cost of basic stunner - $475.00
Cost of air compressor and accumulator - $1500.00

2) Cartridge - the force being generated by the firing of an explosive cartridge, which produces the rapidly expanding gases to drive either a penetrating or a non-penetrating bolt against the head. This type of stunner can take many forms some of which are quite small and light in weight. The different impactive forces required for different animal weights are obtained by selecting cartridges with varying powder charges on the basis of small charge for light animals and large charge for heavy animals.

Operating costs for cartridge-powered stunners are directly dependent on cartridge costs. These vary between approx. $18.00 and $30.00 per 1000 equivalent to 1.8 to 3.0 cents/ head processed. Regular maintenance of the stunner is essential, irrespective of the make and a regular cleaning several times per day and periodic replacement of minor parts are also necessary.

Some types in use are :

"Cash Knocker" - which has a non-penetrating type (mushroom) head.

The operating head is mounted on a handle 1 m long. This assists the stunning of small animals (yearlings) or animals

which persist in lowering their head in the knocking box. However the weight distribution, i.e. a 5.5 kg weight at the end of a 1 m long handle, makes it awkward and tiring to use. In common with all non-penetrating stunners the reactive force, or "kick-back", can be large. Attempts to stun large oxen and bulls with the Cash Knocker were ineffective. This could be attributed to the increased hide and skull thicknesses effectively absorbing the impactive force.

Cost of unit - $244.00
Cost of cartridges - $29.75 per 1000

"Cash Super X Pistol" - a penetrating type.

The pistol form of this stunner makes it very simple to use but on young animals and animals which persist in lowering their heads it is very difficult to place the pistol on the correct spot, i.e. on the forehead. For this reason the bolt very often sticks in the skull and the pistol ends up on the dry landing area. This stunner is effective in stunning bulls when fired correctly positioned on the forehead.

Due to its ease of use and low cost it is very often held as a standby stunner both at the knocking box and dry landing area.

Cost of unit - $85.00
Cost of cartridges - $18.00 per 1000

"Schermer Stunner (Type ME)".

This is a stunner recently introduced to the Australian industry. It is available in both the penetrating and non-penetrating form. As both the main body and firing mechanism are common to both forms it is a low cost method of providing both penetrating and non-penetrating stunners. This stunner is tubular in shape, light in weight and easily held and operated with one hand.

Tests showed that the non-penetrating form was suitable for yearlings and light steers only. Heavy steers (above 400 kg live weight) and bulls require the use of the penetrating form applied to the front of the skull. When used by a trained operator stunning can be effective on all classes of stock, provided the correct choice is made on using either the penetrating or non-penetrating form.

The main disadvantages of this stunner are :

a) The reach of the operator is the limiting factor in positioning the stunner on the animal. For large animals this presents no problem. Yearlings and

lively animals do present a problem as the animal's head is generally close to the top of the knocking box.

b) The firing mechanism is operated by depressing a lever. This has to be co-ordinated with the stunner coming into contact with the animal.

CONCLUSION:

Of the stunners available in Australia no single model is capable of effectively stunning all stock. The reasons for this are clearly in two categories. Firstly, there is the question of mechanical deficiencies in the equipment. Secondly, there is the multiple question of operator skill and care together with considerable variability in size and liveliness of animals compounded by deficiencies in knocking box design. It is not possible to apportion the reasons for stunning problems between these two major causes but observation at various meat works has indicated that operator factors could account for a sizeable proportion of the failures.

Theoretically it would be possible to design and build a stunner which would be capable of stunning all stock. All currently available stunners which are supposed to cope with variable animal sizes, by choosing the appropriate size of cartridge, or by selecting the appropriate air pressure, clearly are not entirely satisfactory. It would appear that at present two stunners are probably required for use under Australian conditions.

Ideally a knocking box should be sized to restrain each individual animal. This is obviously not the case with the present fixed geometry of boxes. Recent overseas developments in the use of "Vee" restrainers could provide an answer to the knocking box problem.

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Date 29th November, 1974 **Number** 74/6

GREENING OF CURED MEAT PRODUCTS

In cured smallgoods the presence of salt, nitrite and certain other ingredients inhibit bacteria that normally cause spoilage of fresh meats. However, such cured meat products act as selective media for other types of bacteria and spoilage can still occur, although normally it takes a different form to that occurring in uncured meats. One type of bacterial spoilage is normally evidenced by the development of a green discolouration.

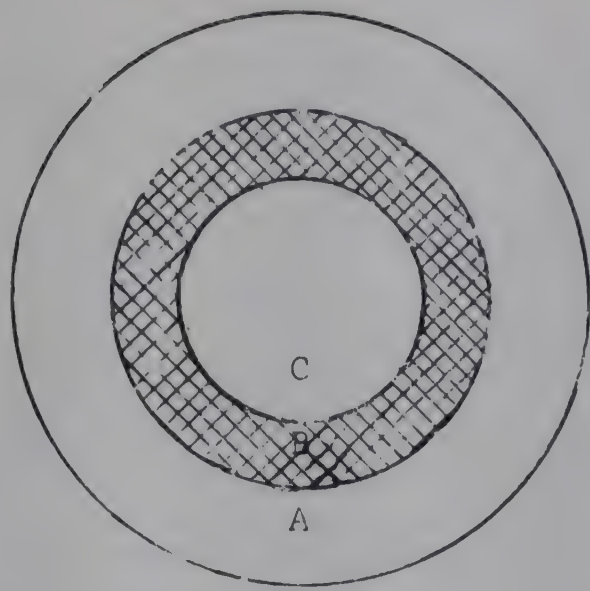
The green discolouration is a product of the reaction between peroxide produced by certain bacteria in the presence of oxygen and the pigment of the cured meat. Interior discolouration is generally indicative of the presence of a high bacterial population in the meat emulsion prior to heat processing. If heat processing is insufficient, this bacterial population continues to grow whenever conditions are suitable. Surface greening is due to post-processing contamination. "Greening" bacteria (Lactobacilli) can grow either in the presence or absence of air but produce greening only in the presence of oxygen. They grow very slowly at temperatures below 5°C.

TYPES OF GREENING:

Bacterial greening can be divided into three types on the basis of where the greening occurs.

GREEN CORES: With this type of greening, the centre of the meat product is discoloured. It usually occurs in products with a large cross sectional area. Discolouration is not visible at the time of cutting, but becomes apparent only after exposure to air one to several hours. This type of bacterial greening is the result of an inadequate heat treatment leaving viable "greening" bacteria in the centre of the product. This is followed by growth of these surviving organisms. Usually a minimum of four days under chiller storage conditions is needed before spoilage can be detected. The discolouration rarely extends more than one-eighth of an inch below the cut surface, and the retailer may be led to believe that the spoilage is confined to this surface. Actually it is throughout the product and colour will reappear after several hours as new surfaces are exposed. The colour change begins in the centre of the meat and will extend from there to the periphery. This spreading of the green area is one of the characteristics which distinguishes microbiological from chemical greening.

GREEN RINGS: These are quite rare. A ring appears at varying depths beneath the surface, and can be seen at the time of cutting (Figure 1). It usually develops 12 to 36 hr after processing, even under adequate refrigeration. Although bacteria may have been present throughout the discolouration develops in a ring, or annular, form because only in this zone are the oxygen tension and other factors conducive to the oxidation of the pigment. The defect is associated with an unusually high population of bacteria in the meat mix before processing. Even though the bacteria may be killed by heat during processing, if there are sufficiently large numbers of greening bacteria in the emulsion the damage may be done before heat is applied, although it may not be apparent.



A. Zone receiving most heat treatment; therefore no surviving greening organisms. (Zones B and C received insufficient heat treatment)

B. Zone of surviving organisms producing green colour to the depth that oxygen penetrates the sausage (aerobic conditions).

C. Zone of surviving greening organism but devoid of oxygen, so no green colour produced.

FIG. 1: Green Ring (Freshly Cut Sausage):

SURFACE GREENING: This type of greening is the most common. It results from contamination of the meat after heat processing, followed by holding conditions that allow extensive growth of the contaminating bacteria. Material cooked in impermeable membranes which are not broken should not show surface greening. However, the removal of casings, slicing or repackaging can result in the recontamination of the product with a wide variety of microorganisms. The bacteria that cause surface greening are the same as those that cause green cores and rings.

CHEMICAL GREENING:

Excess nitrite will cause a greenish appearance. Discolouration due to excess nitrite is more common in fermented-type products and can be seen on both the surface and the interior at the time of cutting. Nitrite is highly reactive in an acid environment and therefore a level that would be considered normal in a frankfurter or ham may result in greening in a fermented sausage.

PREVENTIVE MEASURES:

Any points at which gross bacterial contamination might occur before, during, or after processing or during storage and distribution of the product should be identified.

Stricter control of hygiene in all phases of preparation, careful control of temperatures, and the use of meat only of good microbiological quality will result in a product less likely to be affected. Cooking, provided due regard is given to the maintenance of an adequate internal temperature for sufficient time (e.g. 66-68°C for at least 10 min), will destroy most of the vegetative bacteria present in cured meats. This should be followed by rapid cooling of the product. Bacterial spores, which are relatively heat-resistant, are usually not killed under these conditions, but since spore-forming bacteria cannot grow easily at temperatures close to 0°C, and heating in the presence of nitrite retards their germination, their development may be prevented by rapid cooling immediately after cooking, followed by refrigeration.

Smallgoods made from fresh material enclosed in an impermeable film will normally have a storage life of at least two months provided that they have been cooked adequately and cooled rapidly thereafter before being stored at a low temperature (0°C). Where the product is sliced or cut up, recontamination can occur and particular attention must be paid to cleanliness of equipment and personnel and to adequate refrigeration of the product during storage and transport. Surface greening is commonly traced back to contamination of the cooked product by equipment or tables on which uncooked or returned product has been.

Nitrite greening can be prevented by ensuring that maximum levels of nitrite permitted are not exceeded.

Meat Research News Letter

CSIRO Division of Food Research
Meat Research Laboratory

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Date 11th April, 1975 **Number** 75/2

GUIDELINES FOR THE MANUFACTURE OF MINCED MEAT OF GOOD MICROBIOLOGICAL QUALITY

The National Health and Medical Research Council has recommended to the States that they incorporate into their food regulations a requirement that uncooked chopped or minced meat and uncooked manufactured meat, when examined by the prescribed methods (using 50 g samples), shall be free from Salmonella in at least four of the five portions examined. Uncooked chopped or minced meat and uncooked manufactured meat (excluding uncooked fermented manufactured meat of the salami type), when tested by the prescribed method shall have an aerobic plate count not exceeding 1,000,000 microorganisms per gram in at least three of the five portions examined and not exceeding 10,000,000 micro-organisms per gram in the remaining two portions.

Minced meat, or meat flesh which has been disintegrated by cutting, chopping or mincing provides a highly favourable environment for the growth of bacteria. As the result of disintegration cell juices are liberated and bacteria, normally found on the meat surface, become distributed throughout the product. Consequently, minced meat has a relatively short shelf-life.

An Australia-wide survey by the Meat Research Laboratory of minced meat in butchers shops revealed a somewhat higher incidence of Salmonella than will be permitted under the new standard. It is important to keep Salmonella numbers at a minimum because although

they are destroyed during cooking, accidental transfer from an uncooked food to other foods which have been pre-cooked or are eaten raw may result in food poisoning.

The survey also showed that a high proportion of minced meat gave total aerobic bacterial counts in excess of one million per gram. It is generally accepted that minced meat containing more than 10 million bacteria per gram will discolour rapidly and produce putrid odours.

Since the numbers of bacteria on carcass meats are low enough to ensure that minced meat with low bacterial contamination can be prepared, several butcher's shops were visited in an attempt to discover which stages of production had most influence on the bacteriological quality of minced meat.

GUIDELINES FOR THE MANUFACTURE OF MINCED MEAT OF MICROBIOLOGICAL QUALITY MEETING THE NHMRC RECOMMENDATIONS

A. <u>RAW MATERIALS</u>:

1) All meat used for the manufacture of minced meat should be stored at 0-2°C and minced within 7 days of slaughter. If this is not possible, higher temperatures up to 7°C can be used but the period from slaughter to mincing reduced correspondingly (e.g. 4 days at 4°C, 3 days at 7°C).

Since the quality of the meat purchased will, to a large extent, determine the storage life of the final product it is important that the meat purchased has been stored continuously at 0-2°C. The meat should be transported in refrigerated trucks at a maximum ambient air temperature of 10°C.

2) Meat trimmings should be kept at 0-2°C at all times and should never be allowed to remain at ambient temperature. In addition, they should be minced <u>within 24 hours</u>. If this is not possible they should be frozen.

3) <u>Never</u> mix stale mince into a new batch. Upon storage the bacteria in mince increase rapidly because of the favourable conditions for growth. Thus, the addition of old mince, with large numbers of bacteria would contaminate fresh mince and affect it adversely.

4) All mince should be cooled to 0-2°C <u>before</u> it is placed in the display cabinet. During mincing the temperature of the meat increases, and display cabinets do not have the refrigeration capacity to lower the temperature sufficiently. The temperature of mince can be kept low during mincing by freezing part of the raw material prior to use.

In order to reduce the temperature of fresh mince as quickly as possible, place it in shallow trays and place the trays on racks in a chiller to ensure proper air circulation. Never place the trays on the floor.

B. HYGIENE:

1) Clean and sanitize mincers and all other equipment at the end of the day. Because the mincer is usually in an unrefrigerated room, bacterial growth on any meat left in the mincer will be very rapid and mincers should therefore be cleaned and sanitized whenever they are to be left unused for longer than two hours. At ambient temperature bacteria which cause food poisoning can grow. If possible, the mincer should be situated in a cooled room.

CLEANING PROCEDURE:

a) Mincing Machines:

Ideally the design of mincers should be such that all parts which come into contact with meat can be removed for cleaning.

Wash all parts thoroughly using a medium-alkaline "all-purpose" detergent.

Rinse with clean water.

Spray with or soak in disinfectant* solution allowing contact for not less than 15 minutes.

Rinse with potable water and allow all parts to air dry in a clean room; drying with disposable paper towels is acceptable but cloth or rags should never be used.

Where the equipment cannot be dismantled completely, remove as many parts as possible and clean as described above.

Those parts which cannot be removed such as the feed tunnel and the worm-housing sleeve or casing must be given special attention. The use of cloths or soap pads for this task cannot be recommended. However, clean brushes or plastic scrubbing pads may be used. After cleaning the equipment should be rinsed thoroughly and flushed with a disinfectant solution. Rinse, and then dry the equipment using paper towels. If the equipment is prone to rust, spray all parts with an edible oil, e.g. Ondina Oil.

* Suitable disinfectants include chlorine containing substances, Quaternary ammonium compounds (Quats.) and certain synthetic phenols - all obtainable from any reputable supplier.

b) Trays, knives, aprons, etc.:

Clean thoroughly using a medium-alkaline detergent. Rinse with clean water and soak in disinfectant solution. Rinse and air dry.

c) Cutting Boards:

Clean thoroughly using a medium-alkaline detergent. Rinse with clean water and soak the boards in a hypochlorite solution overnight. Prior to use, rinse with clean water and allow boards to air dry, or dry using paper towels.

Note: It is very important that all clean equipment is dried as quickly as possible since bacteria that have survived the cleaning treatment can grow rapidly in a moist environment.

C. THE PENALTY FOR ALLOWING BACTERIAL GROWTH:

The importance of initial bacterial numbers, and of temperature in controlling the rate of bacterial growth, is illustrated in Table 1.

TABLE 1: Relationship of initial count and storage temperature in determining storage life of mince

Storage Temperature	Number of bacteria per gram				
	Initial Count	1 day	3 days	5 days	7 days
$-1^{\circ}C$	10^3		10^3	10^4	10^5
	10^6		10^8 Spoiled		
$2^{\circ}C$	10^3		10^4	10^6	10^8 Spoiled
	10^6	10^8 Spoiled			
$6^{\circ}C$	10^3		10^6	10^8 Spoiled	
	10^6	$>10^8$ Spoiled			

$10^3 = 1{,}000$; $10^4 = 10{,}000$, etc.

Thus minced meat containing 1,000 bacteria per gram can be kept at -1°C for just over one week, while minced meat containing 1,000,000 per gram can be kept at -1°C for only three days.

The results of the Australia-wide survey showed that the average temperature of minced meat at point of retail sale was about 10°C, while the average bacterial count was in excess of one million indicating that the storage life could be expected to be less than 24 hours.

For these reasons all raw materials should be kept at 0-2°C at all times and should be used within one week after slaughter. If this is not possible all raw materials should be frozen.

CONCLUSION:

If the number of bacteria on the raw materials is kept low by proper temperature control and by observing the rules set out in the above guidelines, minced meat of good bacteriological quality and with a storage life of 3 days can be prepared.

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ACKNOWLEDGEMENT:

The survey mentioned in this News Letter and the examination of manufacturing practice which lead to the production of the guidelines given in this report were carried out under the supervision of Mr. J.C. Bensink now Senior Lecturer, Department of Veterinary Preventive Medicine, University of Queensland.

THE FUTURE OF THE STANDARD FOR MEAT AND MEAT PRODUCTS

The Food Standards Committee of the National Health and Medical Research Council at its December 1974 meeting decided that the Standard for Meat and Meat Products required re-drafting. This action was taken after considering a number of proposals to amend the standard and taking note of statements from the State Health Departments that meat and meat products are regular causes of court action.

The Victorian Health Department has agreed to prepare a new draft of the entire NHMRC Standard for consideration by the Food Standards Committee.

Industry has the opportunity to make submissions on aspects of proposed standards through various bodies associated with their State Chambers of Manufacturers, e.g. the Meat and Allied Trades Federations. Members of the Chambers of the Manufacturers are also eligible to join the Food Technology Association (FTA). FTA members receive details of all proposed amendments and are able to comment through the State FTA to the Council of Australian Food Technology Associations Incorporated (CAFTA).

Representations from companies in the food industry are regularly presented to the Food Standards Committee by CAFTA spokesmen and we believe that this is the most effective channel of communication available. However, very few meat companies appear to avail themselves of this opportunity.

The new Standard for Meat and Meat Products can be expected to contain a subsection relating to microbiological standards and possibly to the use of enzyme treatments for tenderizing meat.

These and other sections of the new Standard may be of vital importance to your company. The Chamber of Manufacturers in your State will advise you how to become a member of the Food Technology Association and <u>how to make sure that your company is well informed on such developments</u>.

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Meat Research News Letter

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Date 10th February, 1975 **Number** 75/1

NOISE

Noise-induced deafness can be a serious occupational hazard in many modern industries. The degree of risk to any individual will depend upon several factors such as the sound pressure level, the type of noise or frequency spectrum, the time exposure pattern each work day and the total time of exposure during a working life.

NATURE OF SOUND

Sound originates from a vibrating source. It radiates as a spherical sound wave travelling in all directions as pressure fluctuations above and below the prevailing air pressures. The movement of sound from source to receiver is achieved by a sequential collision of individual particles in the sound-conducting medium in a chain reaction.

The rate at which the source vibrates and therefore the rate at which the conducting medium pulses, is termed the frequency and is measured in cycles per second (cps). The unit now adopted internationally is hertz (Hz), i.e. 1 Hz is a frequency of one vibration per second.

Ultrasonic is the term used for sound at frequencies above the audible limit, while infrasonic is the equivalent term for frequencies below the limit of audibility.

For young people with well functioning ears the audible range is approximately 20-20,000 Hz but sensitivity is greater to noises in the 500-5,000 Hz range. Low-frequency noise (below 500 Hz) is less damaging to the structure of the ear than high-frequency noise (1,000 Hz and above) of the same sound pressure level. However, low-frequency noise is generally more difficult to control.

An octave is the interval between two sounds having a basic frequency ratio of 2, and in most modern work the octaves are identified by their mid frequencies.

THE UNIT OF MEASUREMENT

Just as "centimetres" are used to measure distance and "degrees" are used to measure temperature, "decibels" are used to measure sound pressure levels.

The ear is sensitive to a wide range of pressures. At the low end (threshold of audibility) the sound pressure is approximately 2×10^{-4} micro bar. A sound pressure of 2×10^{2} micro bar is bordering on the threshold of pain. Since this range is too large to conveniently work with, a logarithm of the ratio of actual sound pressure to a reference pressure (2×10^{-4} micro bar) is used. This number is called a decibel (dB). Zero on the decibel scale corresponds to the lowest point at which sound is audible to humans.

Sound pressure as measured in decibels is not an accurate measure of sound levels actually heard by the human ear unless the frequency is also taken into account. For example the ear would perceive a 70 dB sound of 1,000 Hz to be as loud as a 100 dB sound of 50 Hz.

MEASUREMENT OF SOUND

Sound can be measured with a sound-level meter; this uses a microphone to convert the variations of sound pressure into electrical signals which are then amplified before presentation on a calibrated meter scale.

Performance specifications have been standardized by the Standards Association of Australia for sound level meters as follows:-

Type 1. General purpose sound-level meters ASZ 37/1967

Type 2. Precision sound-level meters ASZ 38/1967

Owing to the way in which ear sensitivity varies with frequency, an overall decibel reading is not usually sufficient for evaluating noise and may be misleading. In an attempt to approximate the ear's response, sound-level meters have weighting circuits and the "A" weighting scale is now frequently used irrespective of the sound level involved. A reading on this scale is referred to as Sound Level "A" or dBA. The response with the "A" weighting scale is modified so that much higher sound pressure levels are required at the low frequencies to obtain the same meter reading as at the middle frequencies. The ear is particularly sensitive to the middle frequency range.

The National Health and Medical Research Council recommend that measurements be taken with the meter set with the weighting network in the "A" position, the meter set to the "slow" response and the average of the excursions of the meter taken as the noise level.

Sound Level "A" can provide a single-figure indication of ear damage risk with occupational noise and an assessment of noise in respect to annoyance both in industry and in the community, but it must be remembered that it has limitations for some purposes.

The noise level in a restaurant may be about 65 dBA, a vacuum cleaner 70 dBA, a boning room around 83 dBA, a sheep-skinning area around 87 dBA, and beef air-knife and circular-saw areas can be in excess of 100 dBA.

FREQUENCY ANALYSIS

As the variation of subjective effects is much more complex than the "weighting networks" can interpret, a more specific analysis of sound may be required in some cases. For this purpose a frequency analyser can be used in conjunction with a sound-level meter, or frequency filters may be incorporated in the meter. The octave bands having the mid frequencies of 500, 1,000, 2,000 and 4,000 Hz are intimately related to hearing damage potential. Bands with mid frequencies of 31.5, 63, 125, 250, 8,000 and 16,000 Hz do have an additive effect but are much less damaging.

MAXIMUM NOISE LEVELS

The National Health and Medical Research Council (November 1973) recommends that no person shall for any time be exposed to a noise level in excess of 115 dBA unless he is wearing personal hearing protective devices. In existing premises it is

recommended that the noise exposure should not exceed a noise level of 90 dBA over an 8-hour day. In all new premises exposure should not exceed a noise level of 85 dBA for 8 hours a day. The latter recommendation will also apply to existing premises within five years of any regulation being brought into force.

The criterion assumes continuous steady state exposure over an 8-hour working day, five days per week. If exposure is less than full time an increase in maximum permitted noise level of 3 dBA is recommended for each halving of exposure time. Thus an 8-hour exposure to 85 dBA is taken as equivalent to 4 hours at 88 dBA, 2 hours at 91 dBA and so on.

Special techniques are required to determine noise exposure in the case of impulse or impact noises (e.g. explosive fastening tools or the hammering of metal).

REDUCTION OF NOISE EXPOSURE

NEW EQUIPMENT

Noise should never be overlooked in the design, purchase and layout of new equipment.

As a guide, when buying new industrial machinery the following figures are suggested as maximum desirable levels in the vicinity of the operator's ear under operating conditions; they are approximately equivalent to 85 dBA.

Desirable Maximum Level for New Equipment

Octave Band Mid Frequencies (Hz)	63	125	250	500	1,000	2,000	4,000	8,000
Maximum Sound pressure level in dB	99	92	86	83	80	78	76	74

If the noise requirements cannot be met, manufacturers should be asked to supply particulars of the noise, so that the purchaser can make comparisons of machines from different suppliers and take the noise into account in his proposed production layout and building design.

Despite the infinite number of machine types, noise can be traced to two main generating mechanisms. Most often noise is generated by vibration of a structure that radiates sound pulsations into the adjacent air. Noise may also be generated by turbulent air such as produced by fans or air blow-offs. In either case, noise generation can be reduced by reducing the disturbance causing the problem, whether it be air turbulence or vibration.

Reduction of vibration can be achieved directly by application of damping materials or vibration absorbers. For instance in an abattoir, impact forces in sticking boxes could be reduced by using pneumatic and hydraulic equipment to operate the door and floor and dissipating any residual energy by using resilient padding at the points of impact.

Vibrational energy can also be controlled by isolating the impact of vibration source from surrounding structures. A familiar example is the rubber placed under heavy machinery such as punch presses. Without these isolators, vibration would be transmitted to the floor, resulting in noise radiation from the floor itself.

EXISTING EQUIPMENT AND PROCESSES

(a) Source

Reduction of noise at the source is a logical first step, if practical. This may be by modification of design to reduce impact, or to spread the blow over a longer period, to reduce the vibration of external surfaces by balancing, damping, stiffening etc., or by the use of silencers. In most cases, noise reduction by engineering modification to existing machines is not practicable.

(b) Between the Source and Receiver

If reduction at the source is not practical then consideration should be given to means of reducing transmission by suitable acoustically designed enclosures, or in some cases barriers. Acoustic tiles have little application in an abattoir because of the requirement that surfaces be smooth and cleanable.

(c) Hearing Protection

Whilst the ultimate aim should always be reduction of noise to a suitable level, there are still many cases where this is either not practical, or it is a long-range matter. There are many forms of personal hearing protection, most of which fall into the following categories:-

Disposable hearing protector

Earplug

Ear canal cup

Ear muff

Helmet

The relevant State Government organisations have expertise in the above areas and should be consulted if further information is needed.

ACKNOWLEDGEMENT

The assistance of Mr. H.R. Weston, Health Commission of New South Wales, Division of Occupational Health and Radiation Control in the preparation of this News Letter is gratefully acknowledged.

Meat Research News Letter

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Date 23rd May, 1975 **Number** 75/3

HOT BRANDING OF MEAT AND OFFAL

It is a requirement of some importing countries that individual offals and meat cuts bear a legible "Australian Approved" brand*. It has been stated that problems have arisen in these countries due to delivery of unbranded and illegibly branded material.

To improve legibility, hot branding is becoming more common. This is done either by heat alone ("fire" brand as in the case of offals) or by heat in conjunction with ink (as in the case of primal cuts).

It is usual to apply both the "fire" brand and the hot ink brand by the use of a metal stamp welded to a metal rod designed to fit into the heated section of a standard commercial soldering iron. It has been shown that acceptable brands can be obtained by this method, provided the time interval between application of brands is adequate to allow the iron to reheat sufficiently. The application of several brands in quick succession cools the iron to such an extent that only the first 2 or 3 brands are acceptable. The higher the wattage the quicker the temperature recovery.

* Refer Australian Department of Agriculture CV M74/27

BRANDING IRONS:

Commercial soldering irons are being used because of their ready availability and low cost. However, it should be remembered that these units are generally designed for use in dry conditions. They are not designed for use in the conditions experienced in offal preparation areas. In selecting soldering irons for use in hot branding in abattoirs it should be remembered that abuse of the unit or even normal wear, could lead to a situation where there is a potential danger to the user. Steps should be taken at the time of purchase and installation to give protection to the operator.

All electrical connections to the branding irons should be fully sealed and capable of being waterproofed. The handle should be of a non-conducting material and of a suitable shape to ensure a good grip by the operator.

ELECTRICAL WIRING:

All electric wiring must be installed by a certified electrici in accordance with the relevant State Electrical Authority requirements. Also the entire installation must be maintained in accordance with the requirements of the Factories and Shops Act. The flexible electric supply cords connecting the branding iron to the power supply should be of a type as defined in the S.A.A. Wiring Rules for the particular application. In addition, particular care should be taken in anchoring the cable at either end to prevent the electrical connection being pulled away from the terminals. The plug socket should be of suitable design for use in a damp situation.

Where an earth wire is necessary the connection in the branding iron should be of a positive locking type. If the earth wire is connected by a simple screw and nut this should be made positive by the application of a suitable cement or solder.

Consideration must be given to the provision of a suitable stand to accommodate the branding iron when not in use. To prevent accidental burns to the operator and damage to the branding iron and connection the stand should be of a fixed type located clear of table tops, possibly on the side frames of the table or on the structures adjacent to the table.

PROTECTION AGAINST ELECTRIC SHOCK:

Potentially, the greatest risk in hot branding is that the operator may receive an electric shock. When branding irons are operated at 240V the danger is always present even with the most stringent controls on installation and regular inspections. The hazard is increased where the operator is working in very humid or wet conditions. There are several methods available to provide protection from electric shock. Where electric branding irons are used it is recommended that one of the following be used.

1. Extra Low Voltage:

The use of 32V has the advantage that it is almost impossible to receive a fatal electric shock. It is therefore the recommended system for use in a damp environment. A suggested layout for such a system is shown in Figure 1.

A possible disadvantage of this layout is that all soldering irons would be controlled by the one Simmerstat. Thus a brander that is used often may cool down while one that is little used may overheat.

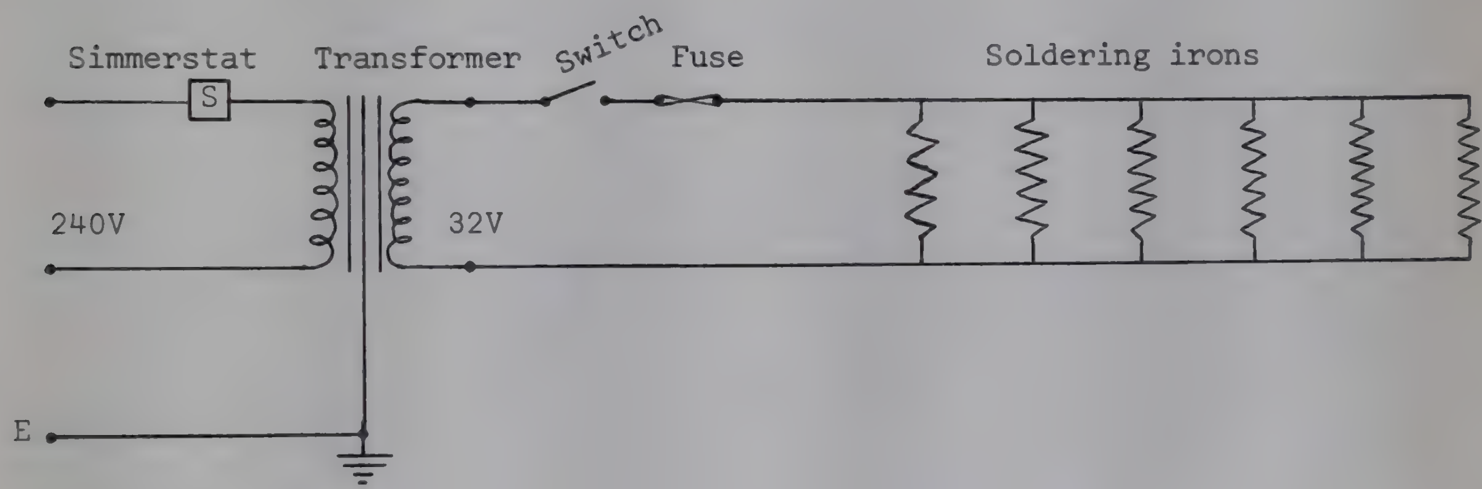

FIG. 1: Diagrammatic layout of 32V system

2. Protection by Core Balance Earth Leakage Unit:

The earth leakage unit detects any leakage to earth of a current above 20-30 mA from an appliance and the supply is switched off in 100 milleseconds, which is less than the time required for electrocution.

A suggested layout is shown in Figure 2. Wiring regulations limit the number of outlets from each earth leakage unit to 6. The cost of a 6-outlet 15A unit is approx. $120.00. The temperature of the brands could be controlled by one Simmerstat located before the earth leakage unit or branders could be individually controlled by a Simmerstat at each outlet.

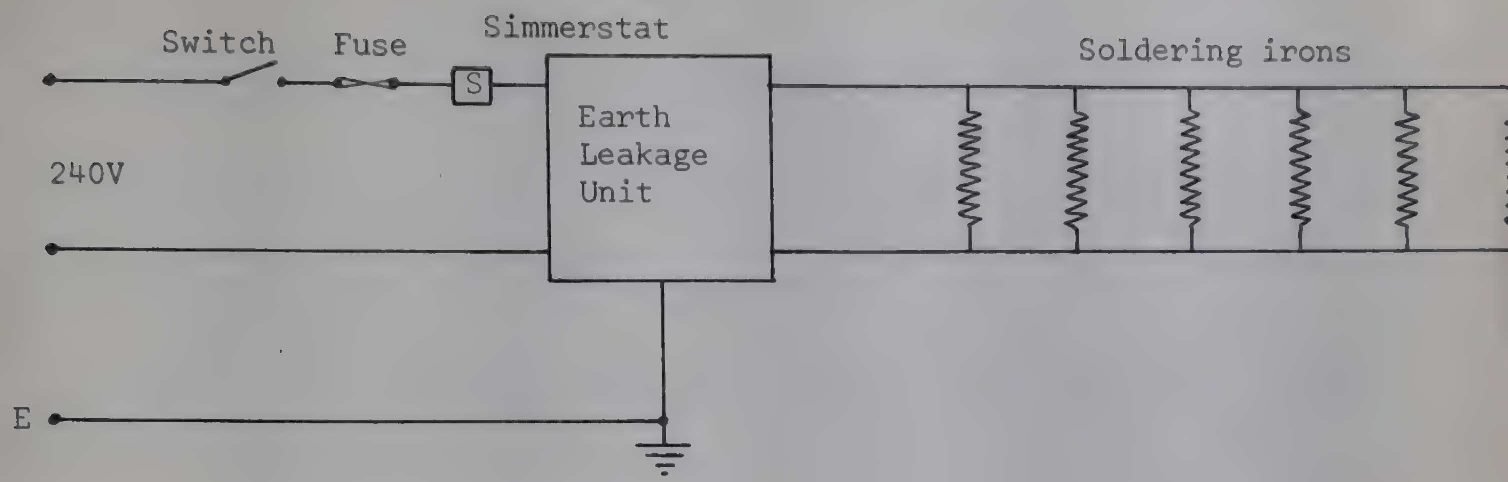

FIG. 2: Diagrammatic layout of earth leakage protection system

3. Protection by Isolating Transformer:

An isolating transformer could be employed but has the disadvantage that only one brander could be run from each unit. The cost of a 250W isolating transformer is approx. $83.00.

Figure 3 shows the layout of such a system.

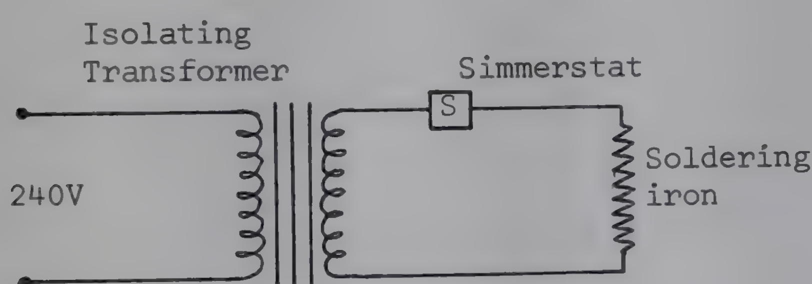

FIG. 3: Diagrammatic layout of isolating transformer protection system

Figures 1, 2 and 3 are diagrammatic only. Approval of each proposed installation must be obtained from the relevant State Electrical Authority to ensure compliance with the various regulations.

A Simmerstat only controls the current supplied to the branding iron in relation to time. The temperature of a branding iron will fall on heavy usage and rise when it is not in use during lunch and tea breaks.

All of the equipment described is available from electrical distributors and wholesalers throughout Australia.

A thermostatically-controlled brander is the obvious solution to the problem. One type is available from an American manufacturer at a cost of approx. $80.00 each and will also shortly be available from a local manufacturer.

CSIRO is proceeding with the development of an improved thermostatically-controlled heat brander for the Australian industry.

ABSTRACTS

Below are some abstracts of recent publications which may be of interest. Copies of publications are restricted to the Australian Meat Processing Industry and can be obtained by completing the attached form. Payment must be made in advance.

1. DELANEY, R.A.M., DONNELLY, J.K., & BENDER, L.D. Concentration and Characterisation of Porcine Blood Plasma. Lebensmittel-Wi-senschaft+Technologie, Vol.8, No.1: p.20-24 (1975). 5p.

'Some of the variables affecting the performance of a laminar flow ultrafiltration plant for concentration duties on porcine blood plasma were investigated. Operation was found to be independent of pressure but strongly dependent on feed flow rate. Using standardised operating conditions pig blood plasma was concentrated to 2.3:1, 3.65:1 and 4.0:1 volumetric concentration ratios in three separate experiments. The concentrated solutions were spray dried directly at an air inlet temperature of 170°C and an outlet temperature of 75°C. The plasma protein concentrates (PPC's) designated PPC 1, PPC 2 and PPC 3 contained 76.2; 86.6 and 88.5% protein respectively on a dry weight basis. Ultrafiltration effected a 55% reduction in the mineral levels in the plasma concentrates (PPC 3). Plasma powders from the ultrafiltration concentrates exhibited protein solubility in water of ca. 100% in the pH range 3-10. Protein solubility was at a minimum at ca. pH 4.0. Ionic background had a very marked effect on protein solubility in water at pH 3.0 (e.g. solubility of PPC 3 fell to ca. 3.0% in 4.0 M NaCl) but had little effect at pH 8.0.'

Authors' Abstract

2. TYBOR, P.T., DILL, C.W., & LANDMANN, W.A. Functional Properties of Proteins Isolated from Bovine Blood by a Continuous Pilot Process. Journal of Food Science, Vol.40, No.1: p.155-159 (1975). 5p.

'Slaughter animal blood yields two distinct protein isolates, the plasma and globin. Protein accounts for better than 90% of each isolate weight. The proteinaceous material is a source of all the essential amino acids but the globin is limited by low levels of isoleucine and methionine. Isolates contained low levels of aerobic bacteria and were free of salmonella, shigella and staphylococci. The solubility of the plasma isolate proteins was dependent upon spray drying conditions while the globin proteins were essentially unresponsive to the same drying treatments. Both isolates are excellent emulsifiers and good foaming agents under optimum conditions of protein concentration and pH.'

Authors' Abstract

3. HAPPICH, M.L., WHITMORE, R.A., FEAIRHELLER, S., TAYLOR, M.M., SWIFT, C.E., NAGHSKI, J., BOOTH, A.N., & ALSMEYER, R.H. Composition and Protein Efficiency Ratio of Partially Defatted Chopped Beef and of Partially defatted Beef Fatty Tissue and Combinations with Selected Proteins. Journal of Food Science, Vol.40, No.1: p.35-39 (1975). 5p.

'Proximate and amino acid composition and the protein efficiency ratio (PER) were determined for partially defatted (PD) chopped beef and PD beef fatty tissue, commercial products from low temperature rendering of beef tissues, to evaluate their protein nutritive quality. Lean beef was included as a reference protein. PER values for PD chopped beef ranged from 1.61-2.58 and for PD beef fatty tissue, 1.13-1.70. Results indicate that the use of a PD cured cooked chopped beef product and of one PD chopped beef product, having PER values equal to or not significantly different from that of casein, are nutritionally acceptable as protein sources. PER's of the products studied were directly correlated with the essential amino acid composition. Data indicate that tryptophan is the most limiting essential amino acid in the PD products and that small amounts had a strikingly beneficial effect on the PER value. PER's for mixtures of two PD beef fatty tissue products individually with lean beef, a whey or a soy protein concentrate were significantly higher than those of the beef fatty tissues individually, ranging from 1.99-2.72. The products would be acceptable as food ingredients when blended with protein foods in which amino acid compositions are mutually supplementary.'

Authors' Abstract

4. ANDERSON, J.R., & GILLETT, T.A. Organoleptic Acceptability of Various Cooked Mutton Salami Formulations. Journal of Food Science, Vol.39, No.6: p.1150-1152 (1974). 3p.

'Salami products were formulated using mutton, pork and beef and subjected to sensory evaluation. Fat and lean ratios were varied in order to determine the levels at which mutton fat and lean could be used and still make an acceptable product. Analysis indicated that mutton fat in excess of 10% of the final product weight adversely affected taste panel scoring. Pork was preferred to beef for use in combination with mutton while a salami product containing 85% mutton and 15% pork was as acceptable as a commercial salami formulation composed of beef and pork.'

Authors' Abstract

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CSIRO Division of Food Research
Meat Research Laboratory

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P O BOX 12, CANNON HILL, BRISBANE, QLD 4170
(CNR CREEK AND WYNNUM ROADS)
TELEPHONE 95 2122. TELEGRAMS FOOD RESEARCH BRISBANE.

Date 25th July, 1975 **Number** 75/4

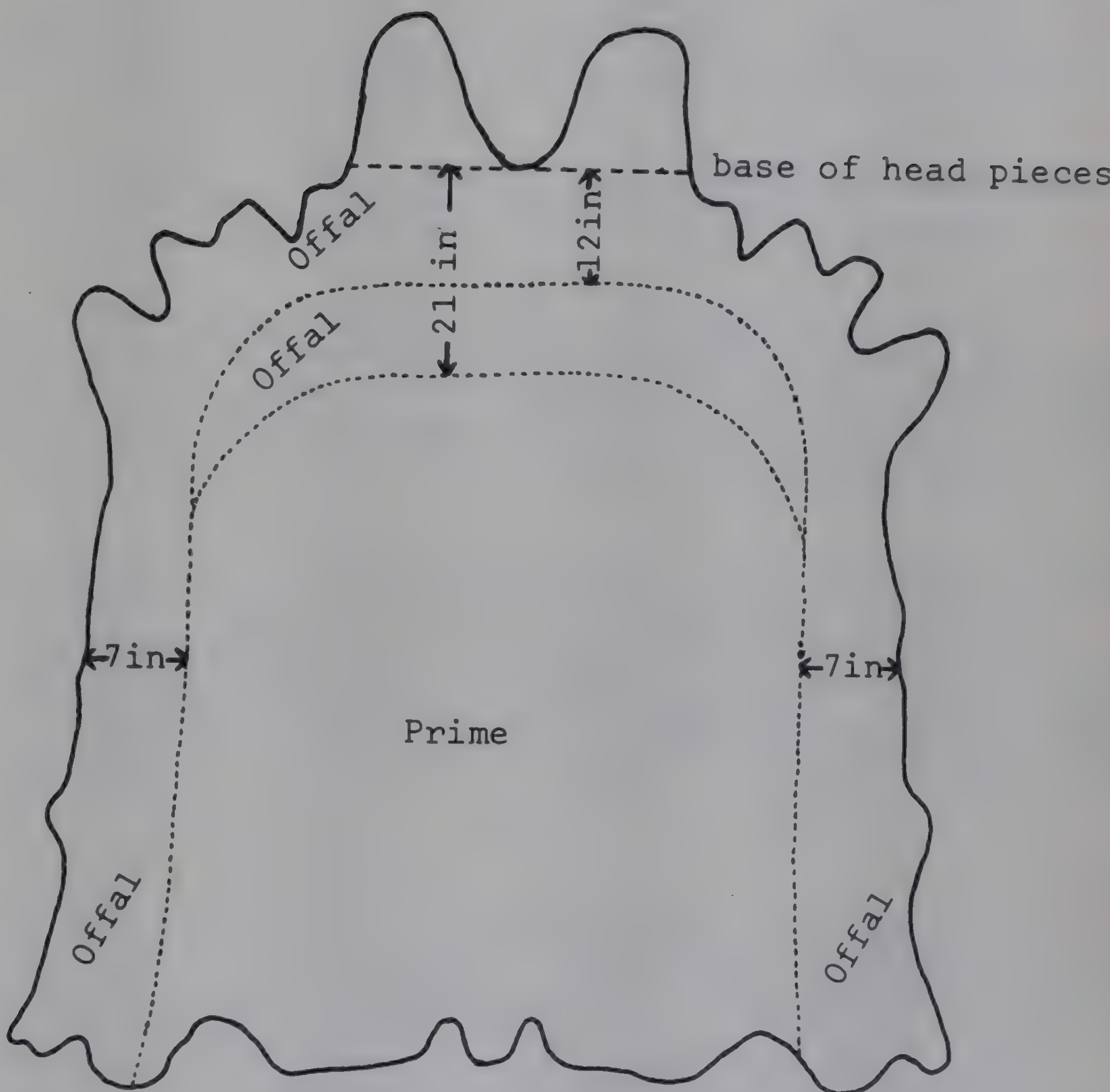
HOW TO INCREASE THE VALUE OF A HIDE

Hides can be worth as much as ten percent of the total value of cattle and are, therefore, a valuable by-product of cattle processing. Hides are often damaged by scratches, disease parasites and brands, all of which result in defects in the leather produced from them.

POSITION OF BRANDS:

One way to reduce losses is by branding cattle carefully. If ear-marks, ear-tags or cheek brands are not sufficient then the position of either a fire-brand or a freeze-brand is very important as both leave scars and the area of hide affected is usually of no value. Also, the position of the brand scar has a great influence on the cutting value of the remaining piece of leather and this is obvious from Figure 1. Positions 1 and 2 are both in a prime area of hide but a brand in position 1, which is at the edge of the hide, is less detrimental than a brand in position 2 as it has less effect on cutting value. For this reason a brand in position 2, 3 or 4 would downgrade the hide more than a brand in position 1. There is an adequate area between the tail and the hip bone for a brand in position 1. Within the limits of State branding regulations processors should therefore advise their cattle suppliers to brand in the least destructive area in terms of hide quality.

FIG. 2:



DEFINITION OF CUT HIDE:

Four or more cuts in offal; or one or more cuts in prime
12-inch margin as above refers to hides under 42 lb
21-inch margin as above refers to hides 42 lb and over
7-inch margin as above refers to all hides

SALTING EFFICIENCY:

1. LACK OF PRESERVATIVES IN CURING SALT:

Poor cure of both hides and sheepskins has been traced to very low levels of additives in commercial salt alleged to contain 1% naphthalene and 1% boric acid so it would be worthwhile to regularly check the levels of these additives. Any salt containing naphthalene should not be stored for long periods before use as the naphthalene will volatilize.

As boric acid is in short supply and is rapidly increasing in price sodium fluoride is often used as an alternative in accordance with News Letter 74/2.

In order to get meaningful curing salt analyses, it is necessary to obtain representative samples of the salt. Experience has shown that samples from different areas of a bag of salt will give different results particularly with the naphthalene analysis. We therefore suggest that the following method of sampling be used :

Lay the bag of salt flat on the floor. Push a clean hollow tube (approximately 1 meter in length and 3-5 cm in diameter) horizontally through the centre of the bag, to the other end. Remove the tube and collect the salt sample from the core of the tube in a suitable container. Repeat the sampling, combine the two core samples and mix thoroughly. From this mixture take your sample for analysis.

a) Naphthalene Analysis:

Weigh 100 g of curing salt accurately in a ground-glass stoppered flask and add 20 g of anhydrous sodium sulphate (to dehydrate the salt); mix thoroughly and allow to stand for approximately 30 minutes. Then, extract the salt (note 4) with 3 x 100-ml aliquots of 40-60°C boiling point petroleum spirit (notes 1, 2 and 3), shaking occasionally. After each extraction, combine the three extracts by carefully filtering the petroleum spirit into a previously-weighed crystallizing dish.

Carefully evaporate the combined petroleum spirit extracts in an indirect current of air (note 5). When the solvent has evaporated, immediately weigh the crystallizing dish containing the extracted naphthalene. Allow the dish and naphthalene to stand at room temperature for 5 minutes and reweigh to check that there was no residual solvent present during the first weighing.

Calculation:

$$\%\ \text{Naphthalene in salt} = \text{crystallizing dish wt.} + \text{Naphthalene} - \text{crystallizing dish wt}$$

Accuracy: 95-100%

NOTES:

1. Petroleum spirit is extremely flammable and mixtures of it and air can be explosive. It is therefore imperative that the extraction be carried out in the absence of any source of flame or heat, i.e. cigarettes, burners, electric elements or hot plates.

2. It has been shown that petroleum spirit (boiling point 40-60^{o}C) is an efficient solvent for naphthalene and does not extract boric acid simultaneously. Solvents that should NOT be used for naphthalene extraction of salts containing boric acid include ACETONE, METHYL ALCOHOL and ETHYL ALCOHOL as they will also extract boric acid, thereby giving high results.

3. Analytical grade petroleum spirit should be used.

4. Ground-glass stoppers should be inserted loosely during each extraction due to high solvent vapour pressure build up.

5. Due to the volatility of naphthalene, particular care is necessary in the concluding stages of the solvent evaporation. This phase should be carefully observed so that the first weighing of the crystallizing dish and naphthalene may be obtained immediately after the last visible trace of solvent has evaporated. Best results have been obtained by standing the evaporating dish in a standard fume cupboard with the draught turned on. If the naphthalene in the crystallizing dish is exposed to the indirect current of air for any length of time after the solvent has evaporated, substantial loss of naphthalene will occur, giving low results.

b) Boric Acid Analysis:

Dissolve 100-g sample of salt in water in a 500-ml standard flask and make up to the mark when all the salt has dissolved. Pipette a 50-ml aliquot into a suitable sized Erlenmeyer flask. Introduce approximately 2-g of mannitol and shake flask until it is all dissolved; add a few drops of phenolphthalene indicator, and titrate with standard 0.1 N sodium hydroxide (carbonate free) until the first permanent faint-pink colour appears.

Add a further 0.5-g (approximately) of mannitol; if the solution becomes colourless, add more standard sodium hydroxide until the permanent faint-pink colour reappears. Repeat this process until addition of mannitol has no effect on the end point.

Calculation:

$$\text{Percent boric acid in salt sample} = \text{titre of sodium hydroxide} \times 0.0625$$

Note: For the above calculation to be valid, the above method of analysis must be followed.

c) Sodium Fluoride Analysis:

The concentration of sodium fluoride in curing salt can be estimated with a fluoride-specific ion electrode.

2. DEGREE OF CURE OF SALTED HIDES:

Regular moisture and ash analysis of salted hides are necessary to determine the degree of cure effected in the hide.

Apparatus: Crucibles, balance (accurate to 4 decimal places), air oven, dessicator with silica gel, Bunsen burner, stand, gauze, muffle furnace.

Method: Accurately weigh a crucible and into this place approximately 10 g of salted hide (diced into small cubes). Weigh crucible + salted hide accurately. Place the crucible and salted hide in an air oven set at approximately 100°C overnight. Remove crucible containing the dry salted hide from oven and place in a dessicator, allow to cool for a few minutes, then weigh. Place the crucible and dry salted hide back into the oven for a further period of about one hour, then again remove, allow to cool in dessicator and reweigh. Repeat this procedure until constant weight is obtained (± 0.01 g).

Then using a Bunsen burner, char the dry sample in the crucible, heating carefully so that sample does not bubble over. Heat until sample ceases to smoke. This should be done in a fume cupboard as the odour is rather unpleasant. Place crucible containing charred sample in the muffle furnace at 650 ± 25°C, and leave overnight. Next morning, place crucible in dessicator, and weigh when cool (residue should be almost white).

Calculation:

$$\% \text{ Moisture} = \frac{\text{Original sample wt.} - \text{Dry sample wt.}}{\text{Original sample wt.}} \times 100$$

$$\% \text{ Ash} = \frac{\text{Ash wt.}}{\text{Original sample wt.}} \times 100$$

The following are the results of some typical analysis:

% Moisture	% Ash	Ash/Moisture Ratio	Degree of Cure
45.9	15.8	0.34	Good
45.4	13.6	0.30	Satisfactory
52.8	13.7	0.26	Unsatisfactory
45.9	12.2	0.27	Unsatisfactory

Ash-moisture ratio should be at least 0.3 and the moisture content should be less than 50% for effective cure.

ACKNOWLEDGEMENT:

This News Letter is based on information supplied by the CSIRO Leather Research Group, Division of Protein Chemistry, 343 Royal Parade, Parkville, Vic. 3052.

ABSTRACTS

Below are some abstracts of recent publications which may be of interest. Copies of publications are restricted to the Australian Meat Processing Industry and can be obtained by completing the attached form. Alternatively, in the case of the article published in "Food Technology," readers may obtain reprints directly from the author, the address of whom is supplied. If the attached form is used, payment must be made in advance.

1. M.C. HUNT, R.A. SMITH, D.H. KROPF & H.J. TUMA. Factors Affecting Showcase Color Stability of Frozen Lamb in Transparent Film. *J. Food Sci. 40*, 637-640 (1975). 4p.

'Display color stability of frozen lamb chops of three marbling levels was studied using all combinations of two freezing temperatures (-40°C and -26°C), two display temperatures (-29°C and -21°C), two packaging films (oxygen permeable L-300 and low oxygen permeable Saran) and two lighting systems (deluxe cool white fluorescent and incandescent). Packaging in oxygen permeable L-300 film resulted in brighter visual scores for fresh packaged chops and frozen chops after display 1 or 42 days, but chops in Saran film had more desirable color after unpackaging and thaw. Reflectance data indicated less metmyoglobin (Mb^+) in chops in Saran when displayed 7 or more days. Freezing at -40°C, compared with -26°C, resulted in more desirable visual color at all time periods post-freezing, confirmed by higher 630 nm reflectance and resulting in no bleach. Display at -29°C, compared with -21°C improved visual color only after 21 days display and after the thaw-bloom period. Reflectance suggested more oxidation of myoglobin occurred at -21°C. Chops displayed and scored under incandescent lighting had more desirable visual color but lighting apparently masked color deterioration as reflectance suggested less Mb^+ in chops displayed under deluxe cool white fluorescent lighting. Marbling level did not affect weight loss or color stability. Drip losses were less in chops frozen at -40°C than at -26°C. Weight loss, from fresh packaged to frozen displayed for 6 wk, averaged 0.71%.'

Authors' Abstract

2. C.L. DAVEY & K.V. GILBERT. Carcass Posture and Tenderness in Frozen Lamb. *J. Sci. Fd Agric. 25*, 923-930 (1974). 8p.

'Toughness in lamb is determined by the extent of cold shortening occurring during chilling, and thaw shortening induced during cooking. Cold shortening sufficient to cause toughening is avoided by placing pre-rigor carcasses in a standing posture. Muscles are then largely restrained from shortening, though stimulated to do so by cold. Thaw shortening with its potential to toughen is eliminated as a problem merely by holding frozen lamb in storage (-12°C) for 20 days or more. These techniques for avoiding cold and thaw shortening can be compounded to form the basis of a simple processing method ensuring a uniform and high degree of tenderness, while still involving early freezing after slaughter. Carcasses are placed in a standing posture after dressing to prevent cold shortening during freezing. They are then held in frozen storage for a period to eliminate the possibility of thaw-rigor shortening on cooking.'

Authors' Abstract

3. H.R.C. MEISCHKE, W.R. RAMSAY & F.D. SHAW. The Effect of Horns on Bruising in Cattle. *Aust. Vet. J. 50*, 432-434 (1974). 3p.

'Bruising in cattle has been the subject of a number of studies in Australia and has been estimated to cost the Australian Meat Industry $22.5 million per year and estimates of average weight of bruise trim per carcase have varied from 0.68 kg to 7.35 kg. Opinions have been expressed both in Australia and overseas that the presence of horns on cattle increases the amount of bruising. McManus and Grieve (1964) recorded the incidence, but not the extent of bruising in mobs of horned and polled cattle in Kenya. Controlled trials designed to compare the amount of bruising in horned and hornless cattle have not been recorded previously. This paper reports the results of three such trials.'

Authors' Abstract Abridged

4. ALFRED WEISSLER*. FDA Regulation of Food Colors. *Food Technology* Vol.29, No.5: p.38 & 46 (May 1975). 2p.

The 11 currently approved synthetic food colors are Blue No.1, Blue No.2, Green No.3, Yellow No.5, Yellow No.6, Red No.2, Red No.3, Red No.4, Red No.40, Orange B and Citrus Red No.2. Eight may be used for coloring foods generally in amounts consistent with good manufacturing practice, but three are restricted to specific uses. The overall outlook for continued use of FD&C colors is good, but nevertheless many previously accepted synthetic food colors have since been rejected after new toxicological test methods. A pertinent food technologist will consider the use of the approved color additives of plant origin, some of which are discussed in this article.

5. C.J. HAGYARD. The Effects of Drying of Bobby-Calf Vells on Milk-Coagulating Activity. *The Australian Journal of Dairy Technology* p.181-184 (December 1974). 4p.

'Drying increases the yield of milk-coagulating enzyme from bobby-calf vells. Dried bobby-calf vells are the common source of rennin used in the New Zealand dairy industry. They are normally preserved by drying. To extract pro-rennin, the vells are finely shredded, mixed with pre-washed gravel and packed into large extraction columns. The pro-rennin is eluted with brine buffered with sodium benzoate, which also acts as a preservative. Pro-rennin is modified in dried vells and on extraction and activation produces rennin of a more active form than that obtained from undried vell material. The two forms of rennin are chromatographically distinct.'

Author's Abstract Augmented

*Chemistry Dept, American University, Washington, DC 20016, U.S.A.

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Date 29th January, 1976 **Number** 76/1

FREEZING OF MEAT

Meat has no definite freezing point because of its complex structure, and behaves more like a weak salt solution, ice crystals being deposited within the muscle fibres, over a range of temperatures beginning near the freezing temperature of water and then continuing to substantially below this. Fig. 1 shows the total heat content of lean beef over the temperature range normally associated with the freezing of meat. This figure shows that the freezing process occurs in three phases.

First phase: Cooling from the initial temperature of the product to the temperature at which freezing begins (about -1.5°C (29.5°F)).

Second phase: Ice begins to form in the product and continues to form over a temperature range from the initial freezing point to about 5°C (9°F) below.

Meat contains approximately 74% water, most of this bound within the cell structure. Only a proportion of this water can be considered as freezable. At a temperature of -10°C (14°F) approximately 82% of the available water is frozen and at -30°C (-22°F), 88% is frozen.

Once water has started to freeze, the rate of ice formation is a function of the rate of heat removal and the rate of diffusion of water from the surrounding cell structures.

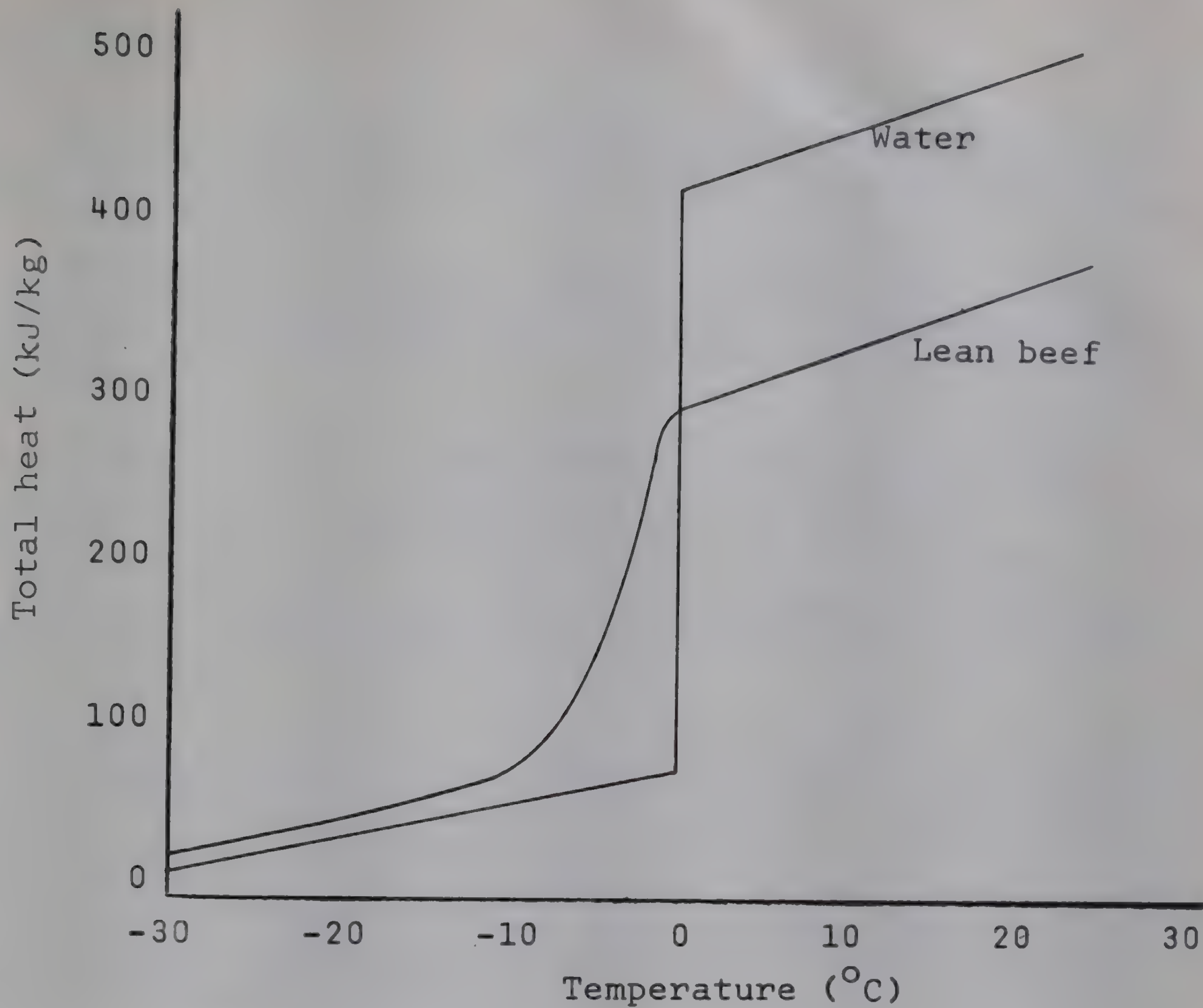


FIG. 1: Total heat content of lean beef over temperature range -30°C to 30°C

At slow rates of freezing, few crystallisation centres are formed. This results in the growth of relatively large ice crystals, which can lead to mechanical damage and excessive losses on thawing due to drip. As the freezing rate increases, the number of ice crystals increases and their size decreases.

Third phase: Cooling to the required temperature for storage. When removed from the freezer, the frozen product will have a non-uniform temperature distribution, being warmer in the centre than at the surfaces.

The cooling of boneless meat from 10°C (50°F) to -12°C (10°F) requires the removal of about 250 kJ/kg (107 BTU/lb) of lean meat (74% water), most of this heat being the latent heat liberated when the liquid water in the meat is changed into ice. Although all the latent heat is not given up at a single freezing point, most of it is produced as the meat is cooled from -1°C (30°F) to -4°C (25°F). Most of the freezing occurs within this 3°C range.

FREEZING TIME

Freezing time for the process depends on many factors. Some relate to the product being frozen, and others to the freezing equipment used.

Calculation of freezing times can be difficult due to the highly variable nature of the product. Any theoretical consideration of freezing times requires some simplifying assumptions.

CALCULATION OF BLAST FREEZER FREEZING TIMES OF BONELESS MEAT IN CARTONS FROM 10^{o} TO $-12^{o}C$ (50^{o} TO $10^{o}F$)

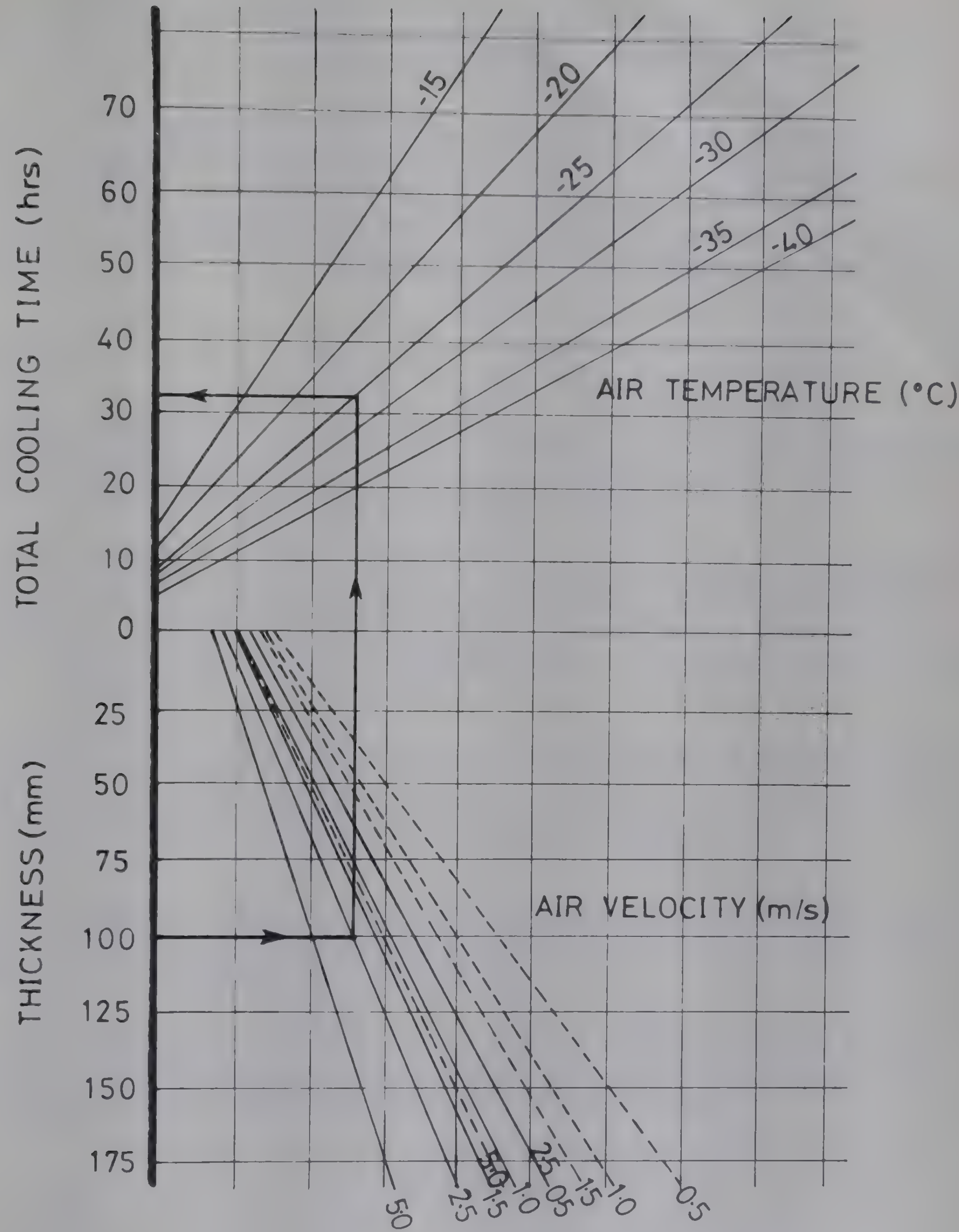
Fig. 2 indicates the effects of product thickness, air velocity, and temperature on cooling times for meat in two types of cartons.

For boneless meat in cartons, the rate of freezing depends on the temperature and velocity of the surrounding air, carton thickness, and the thermal properties of the carton and of the meat itself. The chart shows the effects of the first three factors on cooling times for lean meat in two types of carton. For example, the chart shows a total cooling time of 32 hr for solid cardboard cartons 100 mm thick at an air temperature of $-25^{o}C$ and velocity 2.5 m/s.

For any specified thickness of carton and air velocity, the corresponding air temperatures and cooling times may be read off. Conversely the chart can be used to find the combinations of air velocity and temperature which will be needed to freeze cartons of a particular thickness in a specified time.

Accuracy of the estimated freezing times is approx. 3 percent for air velocities greater than 2 m/s (400 ft/min) and approx. 10 percent with velocities of 0.5 m/s (100 ft/min). Calculations are based on Plank's equation as modified by R.L. Earle. Assumed for lean meat: latent heat of 250 kJ/kg (107 BTU/lb), thermal conductivity of 1.6 W/mK (0.92 BTU/ft hr ^{o}F), and average freezing point of $-2^{o}C$ ($29^{o}F$).

Increasing fat content of the meat reduces the water content and the latent heat per lb of meat. Thermal conductivity of the meat is also reduced, but the overall effect is a decrease in freezing time as the percentage of fat increases. Actual cooling times for mixtures of lean and fatty tissue should therefore be somewhat less than the times obtained from the chart. For meat with 15 percent fat the reduction would be about 17%.



——— Solid cardboard cartons (2.5 mm thick)

----- Corrugated cardboard cartons (3.2 mm thick)

FIG. 2: Effect of product thickness, air velocity and air temperature on cooling time when cooling lean beef from 10°C to -12°C

Air velocities in excess of 5.0 m/s (1,000 ft/min) and air temperatures as low as -40°C (-40°F) are required to achieve a one-day freezing cycle for 150 mm solid fibre cartons.

In theory, increasing the air velocity will increase the rate of heat removal and reduce freezing time. However air velocity approaches an optimum value at approximately 5.0 m/s (1,000 ft/min), as the refrigeration load necessary to remove the heat produced by the fans increases with the cube of the air velocity.

PLATE FREEZERS

Air blast freezing is the most common method of freezing for cartoned meat in use in Australia. Contact, or plate, freezers are also in use in a few meat plants.

In plate freezers, the carton is pressed, by a hydraulic ram, between metal plates which have channels for the refrigerant. This arrangement allows very good heat transfer. Meat works using plate freezers generally operate on a 16 hr freezing cycle, freezing the product to -18°C (0°F).

Where the product has good heat conducting characteristics and is processed in relatively thin, unwrapped sections, e.g. fish, freezing times as short as 2 hr for a 75 mm (3") thickness are possible with a temperature of -34°C (-30°F).

The advantage of good heat transfer at the surface is gradually reduced with increasing thickness of product. Heat transfer is also influenced by packaging materials.

Plate freezing eliminates the bulging that occurs in air blast freezers. Retention of shape is an advantage when the cartons are palletised and stacked in cold stores.

ABSTRACTS

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1. D. PESCOD. Evaporative cooling performance and energy savings in Australia. *Australian Refrigeration* Vol. 29, No. 9, 9-17 (September, 1975). 9p

Indirect evaporative coolers developed in the CSIRO Division of Mechanical Engineering are compared with other forms of space cooling for installations throughout Australia. Simple methods are described for using meteorological data published by the Bureau of Meteorology to give indications of room temperatures and annual energy requirements.

The results of the studies show that evaporative coolers should be suitable for use in all parts of Australia except the humid tropical coastal zones, and that indirect evaporative coolers are best suited to most inland zones. They may also be preferred in southern coastal regions where heat recovery from ventilation air is important in cool weather.

The estimated energy requirements for all types of evaporative coolers are lower than the estimated energy requirements for any refrigeration plant in any zone for which evaporative cooling is applicable.

Author's Abstract

2. S.B. ROBERTSON, Evaporative Cooling in Industry. *Australian Refrigeration* Vol. 29, No. 8, 7-13 (August, 1975). 7p

This paper sets out to establish direct evaporative cooling as an effective and useful means of providing cooling in practically any climate where relief from heat is necessary.

Under present day standards non air-conditioned, new construction office space is the exception, but in new factory space construction the exception is air-conditioned factories.

3. RICHARD K. LYNT, DONALD A. KAUTTER & R.B. READ, Jr. Botulism in Commercially Canned Foods. *J. Milk Food Techno.* 38, No. 9, 546-550 (September, 1975). 5p

Occasionally, a problem thought to be well under control returns to plague us. This is the case with botulism in commercially canned foods. These foods have had a remarkably good record over the last 45 years with approximately 775 billion cans of commercially canned foods being consumed with only four known deaths through 1971. Beginning in 1971, however, botulinal toxin and/or *Clostridium botulinum* has been found in commercially canned

tuna fish, beef stew, and in 41 cans of mushrooms from 20 lots packed by seven domestic and two foreign producers. The typical cause of botulism in canned foods is underprocessing which may result from inadequate equipment, improper operating procedures, and scheduled processes which are not appropriate for the actual operating conditions being used.

Authors' Abstract

4. L.D. SATTERLEE. Improving Utilization of Animal By-Products for Human Foods - A Review. *J. of Ani. Sci.* 41, No. 2, 687-697 (1975). 11p

This paper deals entirely with utilization of animal processing by-products as potential sources of human food. Of the many by-products, blood, milk whey, mechanically deboned meat and desiccated-defatted powders from soft tissues and skin are discussed. Research on the characterization and utilization of these four by-products is sufficiently extensive to show that they possess nutritional, functional and chemical properties which make them feasible for use in the human diet.

All or most of the by-products discussed are presently being used as animal feeds. The present or potential feed value of any of these by-products is not discussed.

Author's Abstract

5. L.B. MacDOUGALL & A.A. TAYLOR. Colour Retention in Fresh Meat Stored in Oxygen - A Commercial Scale Trial. *J. Fd Technol.* 10, 339-347 (1975). 9p

Aged fresh beef was conventionally packaged at a central cutting plant and transported in oxygen filled containers to a retail outlet where it was compared in a refrigerated display cabinet with similar meat held in air. Colour in oxygen and the process was most effective in muscles prone to rapid discolouration. Even a small rise in temperature accelerated discolouration so that good refrigeration during display was still essential.

Authors' Abstract

Authors' Address: Meat Research Institute,
Agricultural Research Council,
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United Kingdom.

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Date 22nd September, 1975 **Number** 75/5

DRIED MEAT PRODUCTS

The possibility of producing dried meat products which could be stored without refrigeration is frequently discussed. During periods when there are surplusses of meat in Australia and people in other parts of the world are starving as part of the aftermath of conflict or drought, especially in over-populated or under-developed regions, the utility of such products seems obvious.

The art of producing air-dried raw meat products has been developed over the ages since man first encountered the problem of preserving meat when a surplus existed. The main products which have evolved are biltong, charqui and pemmican. In this account a description is given of the methods used to prepare these products and comment is made on their applicability now.

BILTONG

Biltong is a salted, dry meat product traditionally prepared by primitive tribal communities in South Africa, and production for consumption outside these communities was formerly limited. More recently, consumption has spread from the native tribes in that country and biltong is now regarded as a delicacy.

The connoisseur seeks tenderness in "binnebiltong" or "ouma se biltong" which is made only from fillet steak. Others claim that the best biltong, "garing biltong", is obtained from the eye muscle. Generally, the muscles of the hindquarter are used and a young animal must be chosen; otherwise the biltong will be too tough.

The selected muscles are dissected along their seams and cut into strips "resembling tongues" (hence biltong) 250-300 mm (approx. 8-12 inches) in length and 50-100 mm (approx. 2-4 inches) in diameter. A comparatively lean well fleshed "buttock" will yield about 70% biltong, 12% trim pieces and 18% bone.

The meat is salted either by immersion in brine or, more often, by packing in dry salt. The longer the biltong is left to salt, the more salt is absorbed and biltong which contain a high proportion of fat take longer to absorb salt than lean biltong. It is difficult to determine quantities of salt and times for salting exactly since personal taste also plays an important role. The basic recipe is 1-2 kg salt for every 50 kg biltong meat and the biltong is left in the container overnight.

Various spices, aniseed, coriander, allspice and garlic mixed (only one at a time) with pepper may be added to the salt. Other options are sugar, salt-petre to promote a red colour, and bicarbonate of soda to counteract mould.

The raw biltong is then hung to dry suspended by strings or wire hooks. Unless drying is rapid, mildew may form. The period of drying and the degree of dryness at which the biltong is considered suitable for further processing appears to be flexible and a matter for the processor's own judgement.

The final product when packed away for storage should be absolutely dry. Although the fat may become rancid, biltong will keep its qualities for many years if it is stored in a dry place. It may also be vacuum packed in plastic film and frozen indefinitely.

For biltong to be prepared either for the Australian market or for export it would be necessary to process it under hygienic conditions. There must be microbiological risk in the traditional method of preparation, and the end product is probably not particularly palatable to the Australian consumer.

CHARQUI

Charqui which is produced in South America differs from biltong in that it is traditionally a very fatty product. As recently as 1947, it was estimated that as many as 600,000 cattle were converted into charqui in Brazil each year. The method used is as follows. A freshly slaughtered side of beef is cut into three pieces, the "manta" which is the meat cut from the bone from the point of the thick rump down to the neck and two "postas" which are the shoulder and leg boned out in single pieces. These pieces of meat are then opened up using large bladed knives, cut into strips similar to biltong and hung to cool at air temperature for about an hour. The strips are then immersed in brine for another hour, drained, dipped in coarse dry salt, stacked in heaps 4-5 ft high, covered in salt, and left overnight. The

pile is turned each day for 4 days putting the strips from the top of one pile at the bottom of the new pile, putting those from the bottom at the top and re-covering with salt. After 4 days, drying is commenced. On the first day the meat is hung over drying racks and exposed to the sun for no more than 2 hours. Then it is removed from the racks and piled in stacks 3-4 ft high under a tarpaulin for 2-3 days to "cure". Drying and curing is repeated 5-7 times until the meat has lost 40% of its weight. The best grade final product contains 20-35% fatty tissue.

It is unknown whether charqui or the "jerkey" made by the North American Indians was the original product. The latter was dried over fires and had a characteristic smokey flavour. A present day American expert has said that jerkey made in the traditional way is not judged very palatable by modern standards.

In common with biltong, the production of charqui is a labour intensive, slow process of a type which would be extremely suspect in the eyes of hygiene conscious communities and authorities.

PEMMICAN

Pemmican is the cold environment equivalent of these products. It was first made in the North American Arctic from indigenous animals such as caribou. Other versions came from Switzerland and Norway. Basically, pemmican is prepared from sun-dried thin strips of lean meat pounded into a fine meal and mixed with rendered fat. The product supplied to polar explorers is basically the same but made from beef and with dried fruit such as currants added to increase its palatability. It is significant that this form of dried meat has been utilized in cold regions where the development of rancidity is relatively slower and the consumption of greater quantities of fat is required to produce the energy required to maintain body warmth. It would be unsuitable for use in warmer zones where it would have to be kept under refrigeration.

SUN-DRIED MEAT

In many hot, dry environments lean meat is dried, without curing, for local consumption but on exposure to high relative humidity it begins to putrefy. Such meat is prepared in inland parts of Australia and within the native communities of other countries. The tendency of the meat to putrefy limits its usefulness.

AIR-DRIED COOKED MEATS

When raw meat is air-dried the end product cannot be restored to a form where it resembles fresh meat, nor can it be

used with any success in recipes in which fresh meat is normally used. The alternative approach is to attempt the drying of cooked meat. Air-drying and freeze-drying have both been developed as commercial processes and applied to minced, cubed, and sliced cooked meat.

Substantial quantities of air-dried precooked mutton mince were produced in Australia during World War II. As there was a shortage of skilled boners at that time the method of production included a rather severe pressure cooking of the meat prior to drying, to facilitate separation of the meat from the bones.

Dried minced meat was consumed only by the armed forces. The product was never issued to domestic consumers. Correspondingl beef and pork products were made in the United States of America and a raw nitrite-cured smoked product (which was said to taste "kippery") was prepared in Germany.

That there is now no production of air-dried cooked meat, although there were ten plants in operation in Australia in the mid-40's, is an indication that these processes were either unecono or that the products were unsatisfactory in some respect. It is recorded that most of the products had a rather poor eating quality, frequently developed off-flavours and had relatively short storage lives. New Zealand prepared beef chunks were said to have a characteristic "processed" or "twice-cooked" flavour. Even after soaking overnight the reconstituted meat tasted slightly dry, slightly tough and woolly and was dark in colour. These defects increased with increase in storage time and temperature.

FREEZE-DRIED MEATS

In freeze-drying, the water in the material being processed is frozen and then removed by sublimation under high vacuum. Mince may be freeze-dried either from the raw or cooked state and the product is undoubtedly better than mince dehydrated by other methods. However, most reconstituted freeze-dried meat still suffers from the texture defect described as "woolliness" and which is also encountered in air-dried meat.

Progress has been made in producing freeze-dried raw beef steaks, cooked meat slices and lamb, mutton and pork chops, but the processes are generally expensive. In normal times there is little commercial demand for these products and much of the development work has been done in armed forces research establishments in various parts of the world. Capital investment and operating costs are known to be high.

Freeze-dried meat shares with air-dried meat a requirement for special packaging. Both products will absorb moisture and oxygen if exposed to the atmosphere with consequent risk of spoilage due to mould and bacterial growth and development of off-flavours. To minimize deterioration, dried minces may be compressed into blocks and packed either in tinplate containers or impermeable foils and films from which the air has been evacuated or replaced by gas such as carbon dioxide or nitrogen.

CONCLUSION

The preparation of dried meat products either by traditional methods or by using modern technology is expensive. The former methods are extremely labour intensive, frequently wasteful, and the keeping properties of the final product without refrigeration are often poor. The end product is likely to be of limited appeal. In any country where capital and labour costs are high, commercial production would be prohibitive except to cater for a high price delicacy market. Even the products of modern freeze-drying technology have limited shelf lives and whilst the eating qualities may be satisfactory the nutritional value may deteriorate rapidly unless storage is at cold or cool, temperatures.

To dismiss dried meat products as having no future would be to ignore the possibility of increasing the total consumption of meat in unconventional forms. As mentioned earlier, biltong is becoming widely accepted as a delicacy in Africa. In North America jerkey is eaten dry-cured, pickle cured, hot pickle cured or marinated. In Europe, a dried cured beef product sold as "Viande des Grisons", "Binden Fleisch" or "Bünder Fleisch" is used in weight reducing diets and is prepared from beef carefully trimmed to remove fat, aged for one week, rubbed in a special curing mixture and dry-cured in stacks for 3-4 weeks at 6-8°C.

Freeze-drying may have greater commercial application in the future as technology improves. There is already a demand for imported freeze-dried mince in light weight packs among the increasing numbers of bush walkers and others who carry their own rations in their pursuit of freedom away from civilization.

ABSTRACTS

Below are some abstracts of recent publications which may be of interest. Copies of publications are restricted to the Australian Meat Processing Industry and can be obtained by completing the attached form. Alternatively, in the case of the article published in *Food Technology*, readers may obtain reprints directly from the author, the address of whom is supplied. If the attached form is used, payment must be made in advance.

1. J.R. SIMPSON & D.E. FARRIS. The Benefits for Economic Developm from Selected South American Beef Exports. *World Animal Reviev* No.13, 9-15 (1975) 7p

Four South American countries - Argentina, Brazil, Paraguay and Uruguay - were studied in this economic analysis of the beef export industry. Five different beef exports were selected - live cows, bone-in beef quarters, frozen boneless manufacturing beef, cooked/frozen beef and canned beef - and the analysis was limited to cow beef. Detailed studies were made of the earning power of each product, and the extensive increase in the industry, particularly i cooked/frozen meat, in recent years is pointed out. It is also suggested that where there is unemployment and a constant need for increasing business activity and foreign exchange, national policy makers could well afford to consider those policies that would encourage the production and export of cooked/frozen beef and canne beef.

2. L.E. GRIVETTI.* The Importance of Flavours in the Middle East. *Food Technology 29*, No.6, 38 & 40 (1975) 2p

The area under consideration extends from Morocco eastward to Pakistan and from Greece and Turkey southward to the Sudan in Afric Besides the cultural and geographical influences, many religious cults too affect the consumption of food. A bitter taste in many foods is prevalent throughout the Middle East, but so too is a swee flavor, noted instantly by visitors to the area. Great use is made of pickled foods, but salted dried meats are expensive and are not consumed by the poor. Greeks and Egyptians never eat sweet foods such as mint jelly or cranberry sauce with meat, as do the American A sweet taste is reserved for dessert. An analysis is made of the cultural preferences of the various countries and their influence o the consumption of food, and the mystery of why certain flavors are accepted and others rejected is discussed.

3. C.L. KASTNER, R.L. HENRICKSON & R.D. MORRISON. Characteristics of Hot Boned Bovine Muscle. *Journal of Animal Science 36*, No.3 484-487 (1973) 4p

Six Hereford steer carcasses were assigned to each of three holding periods (either 2-, 5- or 8-hr postmortem). Each carcass was split

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and one side was "hot" boned into muscles and muscle systems after being held intact for the assigned holding period at 16^{o}C. The corresponding sides were fabricated into the muscles and muscle systems after chilling for 48 hr at 2^{o}C ("cold" boned).

When the sides to be "hot" boned were held intact for 8 hr postmorte then fabricated, the "hot" boned steaks were equal or superior to those "cold" boned when the following parameters were compared: shrink (percent loss), shear force, colour value notation, flavor, cooking loss, water-binding capacity, percent moisture and fat.

(Author's Abstract)

4. J.J. MADIGAN. How to Determine the Precision of Your Analyses. *Meat Processing*, April 22, 1975, 82-85. 4p

The meat industry requires a large number of composition analyses both in the laboratory and often quickly on the production line. With a growing variety of methods and machines available to make those analyses, there is a strong need for simple and understandable programs which can be used to determine the precision in analysis an the reliability in operation which can be expected from any proposed machine or method. The fat content of meat is used for purposes of discussion, and three areas of analysis are stressed - reproducibili calibration and system stability, and operational reliability. Various definitions of analysis are detailed, and it is stressed tha wherever possible, the same sample should be used for analysis and re-analysis. A detailed method of analysis is described.

5. P.T. TYBOR, C.W. DILL & W.A. LANDMANN. Functional Properties of Proteins Isolated from Bovine Blood by a Continuous Pilot Proces *Journal of Food Science 40*, 155-159 (1975) 5p

A procedure is described for preparing plasma and globin protein isolates from beef blood, and the functional properties of the isolates are studied. The blood was separated into plasma and red blood cell fractions using a cream separator. The plasma (the aqueo fraction) was spray dried, while the red cells were hemolyzed and th globin fraction was isolated by a special procedure. Thus, the meth gave two protein isolates consisting of the plasma and globin fractions, each of which contained over 90% protein.

Although the solubility of the plasma proteins was reduced by spray drying, incorporation of one part of lactose to one part of protein prior to spray drying in both isolates maintained their original solubility.

It was reported that the plasma and globin isolates from blood could provide large quantities of protein, which has potential for human food. Both isolates were excellent sources of lysine and leucine, while isoleucine and methionine were shown to be the limiting amino acids. The protein isolates were also shown to have low numbers of aerobic bacteria and pathogenic microorganisms. Thus they were judged to be microbiologically safe.

(Dr. A.M. Pearson's Abstract)

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Meat Research News Letter

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Date 30th March 1976

Number 76/2

STONEY OR PIMPLY GUT

The value of sheep and lamb casings produced in Australia each year is approximately fourteen million dollars. The major single cause preventing increased returns is the condition known as stoney or pimply gut (Fig.1) which makes the intestines useless for sausage skins.

Pimply gut is caused by nodule worms (*Oesophagostomum columbianum*), which infest millions of Australian sheep and lambs.

The nodule worm also causes considerable loss to the sheep industry because heavily infested sheep do not fatten and wool growth suffers.

The nodule worm is found chiefly in summer rainfall regions, and is widespread in the higher rainfall regions of Queensland and northern and north-western New South Wales (Fig.2). About 20% of all Australian sheep are grazed in regions affected by the parasite.

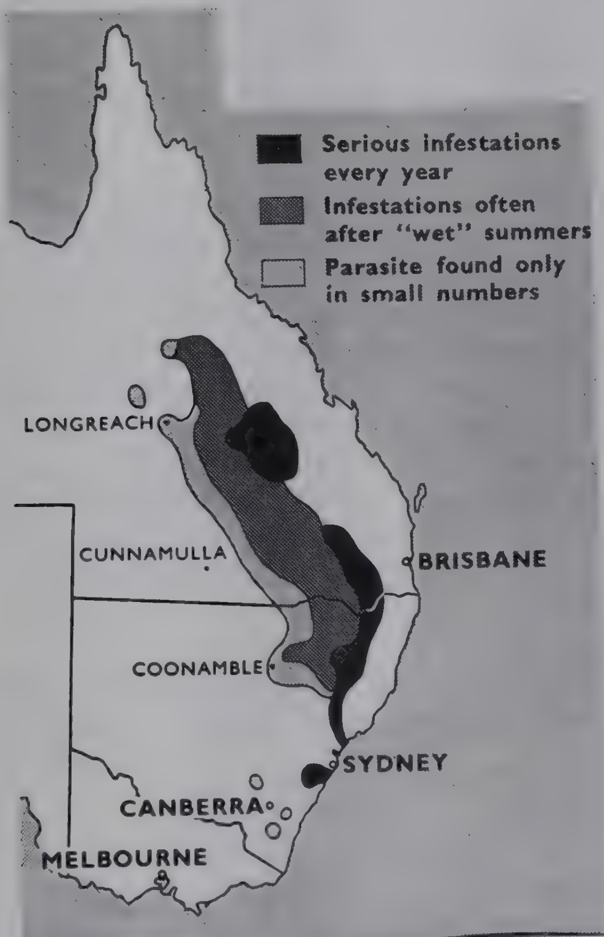

Fig.2 Distribution of Nodule Larvae

LIFE HISTORY

The eggs laid by the adult worm in the intestine hatch 24 hours after passing out of the host with faeces, and after undergoing two moults (moults are basically the shedding of the outer skin as the larvae mature), the larvae ascend blades of grass, becoming potentially infective. The significance of these moults is that the egg and the first and second-stage larvae are

usually very sensitive to environmental stresses such as desiccation and cold. It is at this stage that many may die. In the third stage of development, the larvae are better able to withstand stress. The time lapse between the egg and infective stage is variable. Given moisture, oxygen and a favourable temperature, the third infective stage is reached six to seven days after the eggs have been passed in the faeces. If larvae ar ingested immediately by a sheep, eggs from the resulting mature worms appear 41 days after initial infection.

During the second moult the old cuticle is not shed completely but becomes a protective sheath for the infective larval form. When consumed by sheep the larvae pass to the intestine; the sheath is cast off and the larvae penetrate the bowel mucosa. While in the mucosa they moult and become the fourth-stage larvae.

In nonsensitized animals the larvae remain in the mucosa for five to seven days and then return to the lumen of the bowel without producing a nodule. In sensitized animals, the infective form of the larvae pass to the submucosa, and an intense reaction takes place in the form of local inflammation. There is a massiv infiltration of leucocytes, and the focus becomes encapsulated by fibroblasts. Initially, pus forms, which in the course of time may become calcified. The larvae can remain in the intestinal wall for up to three months before the contents of the nodule commence to calcify. At this point the larvae then either leave the host or die. Calcified nodules may or may not contain dead larvae.

The larvae that leave the intestinal wall develop into matur worms that produce eggs, which are voided in the faeces to begin the life cycle again.

CONTROL

Control of the sheep nodule worm is relatively simple. Properly timed seasonal drenching with modern, broad spectrum drenches is effective against both mature and immature worms. Th State Departments of Agriculture or the Queensland Department of Primary Industries should be consulted for control details.

The Queensland Department of Primary Industries recommends that treatment be given in the late winter months, for by this time there should be little chance of fresh infection, and the majority of larvae ingested by sheep in the autumn will have emerged from the nodules. Removal of the worms at this time by drenching will assist in preventing contamination of pastures wit eggs. Breeding ewes should be given close attention to minimise the incidence of infection in lambs.

The three following rules are important in controlling nodule worm:

1) An efficient method of treatment

2) Treatment at the correct season of the year to remove the worms at a time when least re-infection is likely from pastures

3) Spelling of paddocks from sheep, and rotational grazing by cattle and horses.

Nodules in the walls of sheep and lamb intestines make them useless for sausage casings. Feedback of information on the finding of nodules to the livestock producer for appropriate action could help to reduce this problem.

ABSTRACTS

Below are some abstracts of recent publications which may be of interest. Copies of publications are restricted to the Australian Meat Processing Industry and can be obtained by completing the attached form. Payment must be made in advance.

1. DOUGLAS B. MacDOUGALL, DONALD S. MOTTRAM & DOUGLAS N. RHODES. Contribution of Nitrite and Nitrate to the Colour and Flavour of Cured Meats. *J. Sci. Fd Agric.* 1975, 26, 1743-1754. 12p

The formation of nitric oxide myoglobin from nitrite and myoglobin involves a complex series of reactions not all of which are completely understood even now, and the stability of the cured colour, so important from the marketing point of view, continues to be investigated. The amount of nitrite necessary for complete formation of nitric oxide myoglobin is very small and the presence of no more than 25 mg/kg of nitrite in the cured meat is enough to ensure an adequately stable colour. At least four times this level is essential to produce a full development of the typical cured flavour. Very little is known of the mechanism of the reactions leading to the formation of cured flavours in cooked products or of the identity of the volatile substances responsible for it.

Authors' Abstract

2. DAVID C. SAMMON & BRIAN STRINGER. The Application of Membrane Processes in the Treatment of Sewage. *Process Biochemistry*, March 1975, 4-12. 9p

Reverse osmosis, ultrafiltration and electrodialysis are now becoming established as water treatment processes and have been evaluated for the treatment of sewage effluents. Much of the work was performed in the U.S.A. and a great amount of information has been published on the problems associated with operation on feeds that contain appreciable quantities of suspended solids. Product quality has also been extensively discussed. Cost estimates have been made from pilot plant studies, but these must be taken as indicative rather than definitive. The most assured application appears to be in cases of extensive re-use where the salt content must be reduced.

Authors' Abstract

3. GUN ERIKSSON & IRENE VON BOCKELMANN. Ultrafiltration of Animal Blood Serum: Technology and Microbiology. *Process Biochemistry* Vol.10, No.7, 11-14 (September 1975). 4p

The aim of this study was to investigate the possibilities of concentrating serum proteins by ultrafiltration. The study involved determination of operating parameters such as flux vs time, flux vs concentration and microbiological growth during processing.

Authors' Abstract

4. RORY A.M. DELANEY. The Nutritive Value of Porcine Blood Plasma Concentrates Prepared by Ultrafiltration and Spray Drying. *J. Sci. Fd Agric.* 26, 303-310. 8p

Concentrated solutions of porcine blood plasma proteins, prepared by centrifugation and ultrafiltration were spray dried directly at air inlet temperatures of 154, 170.3, 225 and 243.2°C. Spray dried concentrates contained 86-90% protein, 2-7% moisture and 5% minerals. The overall amino acid composition of the plasma proteins compared favourably with that of FAO whole egg protein. Although the values of essential amino acids generally fell below the egg values, the only serious limitations were in the content of isoleucine (less than half of the egg value). The chemical score and essential amino acid index were 49.1 and 70.1 respectively. Rats fed on a diet containing plasma concentrate as the sole protein source showed a net weight increase. Net protein utilisation carcass for plasma protein was 65.8 ± 1.9 compared with a value of 72.1 ± 0.4 for a casein control. An inverse correlation between denaturation status of plasma proteins and spray drying temperature was found. The percent denaturation as measured on pH 4.0 filtrates increased from 8.4% at an air inlet temperature of 154°C to 48.6% at a temperature of 243.2°C. A similar inverse relationship was found between the available lysine content of plasma proteins and spray drying temperature. A maximum decrease in percent lysine availability of 16% was found at an air inlet drying temperature of 243.4°C.

Author's Abstract

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Date 10th September 1976 **Number** 76/5

INDUSTRIAL LIGHTING IN MEAT PROCESSING PLANTS

QUALITY AND GUANTITY OF ILLUMINATION

Whether lighting is artificial or natural, cr a combination of both, it is well recognised that good lighting is essential for any critical visual task.

The question follows, what is good lighting? Most meatworks managers might be satisfied that it is achieved when the levels of illumination for tasks like slaughtering, boning, inspection, etc. in lux meet the specifications of the Bureau of Animal Health.

QUALITY OF LIGHT

The perceptive observer in the industry realises that adequate quantity of light is only one of the necessary elements for satisfactory visual perception, particularly for such tasks as inspection for meat grading, detection of contamination, disease, colour and the like. Failure to achieve the light quality aspects can reduce the efficiency of assessing meat quality or defects and thereby enhances the possibility of rejection on subsequent inspection. Poor *quality* lighting, even though there is *enough* of it, can cause the visual discomfort of meat processing operators and such discomfort may be manifested by complaints of fatigue, eye strain and headaches.

Unfortunately some of these effects on operators are not always immediately apparent when working under particular light conditions for a short period. Like the effect of the hard seat on the sitter, there is a weighted time factor which makes seemingly low levels of glare accumulate with a time span of some hours into positive personal discomfort. Some individuals, as might be expected, are more sensitive than others.

Reference to local or overseas standards lighting codes of practice such as, for example, Australian Standard CA 30-1965 "Artificial Lighting of Buildings" will reveal what the important quality requirements are.

Any manager who wants to ensure that lighting conditions are satisfactory is advised to follow carefully such code recommendations. The Australian Code is under revision and the new version should be available in 1976. However, in the meantime, the existing Code CA 30-1965 is an adequate source of the requirements of lighting quality, should it be desirable to take steps to effect improvements immediately.

The new code will effect conversion to metric units and it will be necessary to become familiar with the term lux in place of lumens per square foot. Fortunately it is easy to remember that one square meter is about 11 square feet (10.76 more accurately) and one lux is equivalent to one lumen per square meter. Therefore one lumen per square foot (lm/sq.ft) equals about 11 lux (i.e. 11 lumens per square meter).

The new code will introduce a number of refinements which, in the 11 years since the previous code was published, are to be expected. Readers will also find that the content will be increased because much more detail is shown to explain the reasons for recommendations. The code will include extended guidance on glare, and good practical advice on the use of colour. It will be worth purchasing when it is available.

In the meantime, how can CA 30-1965 be applied? If a new plant is being planned, an existing one is being extended, or lighting installation is being renewed, reference should be made to the code by technical staff and/or consultants who may be doing the design and installation.

One thing is certain; it has been the experience of Labour Departments like the Department of Employment and Industrial Relations that lighting installations causing visual discomfort and/or positively reducing visual efficiency mostly arise from failing to meet the SAA code recommendations. Remember the object of the code is to prescribe minimum requirements for comfort and efficiency.

Another aspect, also important, is the vision of employees carrying out the tasks that are visually important. This newsletter assumes that care has been taken to obtain professional advice from an industrial medical officer or an experienced industrial eye specialist. Good lighting won't necessarily compensate for deficient vision.

CA 30-1965 explains five important aspects of the illumination quality code. They are *direct glare, reflected glare, brightness distribution, colour temperature and colour rendering properties* of lamps.

Direct glare occurs when there is an over bright source of light directly in the field of view. Factors that determine its severity are its inherent degree of brightness, its apparent area or size to the eye, its angular displacement from the general direction for the task, and the relative brightness of the background immediately surrounding it. An over bright lamp in meatworks should not be close to the line of sight, or if it is, steps should be taken to shade it or otherwise limit the glare effect as the code advises.

The Australian code gives practical guidance on the assessment of whether a particular luminaire (the international term for light fitting) by rating and type is too bright or not, and gives appropriate measures to its brightness control. These include the provision of luminance (brightness measured by instrument) limits on the luminaire, suitable shielding angles for shades and louvres, and minimum mounting heights for lamps of given light output. A lamp is not the same as a luminaire. 40W globes or 40W fluorescent tubes are lamps. A luminaire is lamp(s) plus surrounding light control hardware.

A brief survey of a few abattoirs and boning rooms in New South Wales in 1972 by a Labour Department Lighting Adviser revealed instances of direct glare in the meatworker's visual field. Examples seen were incandescent reflector spot lamps mounted over boning tables and at a height just above the heads of boners, and high intensity 500W tungsten halide lamps mounted close to the visual field of boners. Bare fluorescent lamps were mounted just above the line of vision of slaughterline workers who look for and remove defects.

Luminaires on inspection and work stations were seen in positions where possible troublesome *reflections* were directed to inspectors' eyes from wet surfaces of offal on the viscera conveyor, from polished stainless steel working surfaces, or from glossy wall tiles and even water lying on the floor. The SAA code gives guidance on the ways of eliminating or minimising such effects.

Brightness distribution (the pattern of brightness that appears in the field of vision) is an important factor in the visual efficiency of demanding tasks in locations such as the boning room and the slaughter line.

It is important that the brightness of the object examined (the luminance) is greater than the remainder of the field of view. The background should present a comfortable brightness distribution. However, if the *difference* in luminance between the object examined and the immediate background is too great (i.e. greater than about four to one), the worker could have problems of adjusting back and forth between the two light levels, thus affecting his visual performance.

The slicer or spotter in the boning room has a demanding task in light levels of from 400 to 600 lux (about 40-60 lm/sq. ft). Those performing such a task will tend to seek momentary visual relief at intervals by glancing at surroundings: a normal habit for such a job. Even so, if the ratio of the object examined brightness to the background brightness is more than four to one, visual discomfort could be experienced.

Dark ceilings and backgrounds in boning rooms are not an uncommon sight for two reasons. Firstly, only a small proportion of light is *directed* to walls and ceilings, and secondly, surfaces commonly have low reflection factors; that is, they are too dark in colour. Appendix D of the SAA code suggests that ceiling finishes typically should have a minimum reflectance of 75% and walls 50%. Thus as well as the concentrated directional light on the slicing and spotting operations of the boning room, it is important to have an adequate level of general illumination (illuminance) making ceilings and walls comfortably bright for those who glance up from task areas of high brightness. The SAA code makes particular emphasis on the methods for the achievement of this type of light distribution.

COLOUR APPEARANCE

Light from available sources - fluorescent, incandescent, etc. - can range from a high colour temperature bluish white to a low colour temperature warm, yellowish white. A consideration of two source characteristics - colour temperature and colour rendering - will provide the answer to the question of optimum interior colour appearance of objects and therefore enable the selection of the most appropriate source for the particular visual requirements of the task.

Colour temperature is a figure that gives a measure of the colour of light from the lamp itself.

If a 'black body' is heated, it begins to radiate heat energy. As the temperature is steadily increased, visible light begins to be emitted when it becomes "red hot" at about 600°C (nearly 900°K), becoming yellow at 1,500°K and rising through the colours to give so called "white light." This white light is made up of light of different colours, i.e. of different wavelengths, and as the temperature of the black body rises, the colour of the light changes from having mainly red/yellow components at about 2,500°K to light having mainly blue components at about 6,500°K, which approximates natural daylight with a blue sky.

To obtain the colour temperature of a particular lamp, the spectral energy distribution curve, which is a plot of the relative distribution with wavelength of the light emitted by the lamp, is compared with the spectral curve of a perfect ('black body') radiator. The temperature of the perfect radiator spectral curve which most closely matches the spectral curve of the sample lamp is designated the colour temperature of the sample lamp under test.

Some light sources such as incandescent lamps and fluorescent lamps give spectral curves which are similar in shape to perfect radiator spectral curves. These curves are easy to match and an accurate colour temperature can be obtained. Other sources like high pressure mercury vapour lamps give spectral curves which are a series of peaks and troughs. This type of curve is difficult to match with the smooth spectral curve of a perfect radiator, and colour temperature is not a meaningful description of the spectral energy distribution of the lamp.

Fluorescent lamps with colour temperatures in the range 3,000°K to 4,500°K are preferred for commercial and industrial applications, the higher colour temperature lamps being used where higher luminance is required. Colour temperatures in the region of 4,300°K are most suitable for tasks in abattoirs especially where visual efficiency is critical, e.g. inspection. Lamps with these or higher colour temperatures may be called "white light" or "daylight" fluorescent lamps. The colour temperature of "warm white" lamps (below 3,500°K) is a little low to achieve the illumance required for the critical visual tasks in abattoirs. At inspection points a colour temperature of 4,000°K-4,500°K is recommended, provided that the lamp has suitable colour rendering properties.

Tungsten lamps at 2,700°K have about the right colour temperature for use in homes, leisure areas and some industrial applications, although we know that when we want a low level of illumination in our homes we usually prefer to "warm up" the tungsten lamp by putting a pink or yellow shade around it. Warm white fluorescent lamps (3,000°K) are acceptable for homes and hotels, particularly when the higher illuminances are used.

Colour Rendering

This is the general expression for the effect of a light source on the colour appearance of objects in comparison with their colour appearance under a reference light source. The general Colour Rendering Index (CRI) of a lamp is determined by comparing the appearance of a set of eight standard colours illuminated first by the sample source and then by a perfect radiator (black body below 5,000°K or daylight above 5,000°K). A figure for the CRI of the light source is computed from the difference in appearance of the eight colours illuminated under the two conditions.

Light sources with colour rendering indices of 100 might be assumed to have, by definition, "perfect" colour rendering properties. Those with lower indices will have colour deficiencies and, in broad terms, become less suitable for faithful rendering of the "normal" colour of objects as the index becomes less.

In practice the index of a light source will be less than 100 because one or more of the eight standard colours will have an appearance, under the lamp in question, different from that seen under the reference source. However, because the index is derived from the *mean* of eight measurements, it doesn't tell us anything about any individual colour measurement. An index of 75 may indicate deficiencies in, say, red or blue rendering, but it is not possible to tell which.

The so called "good colour" fluorescent lamps, that is to say, National and De Luxe Warm White and Colour Matching, all have CRIs above 80 and the colour rendering qualities of these lamps are significantly better than those of Warm White and White, but in practice the difference is not sufficiently great, except where colour is critical (such as inspection points), to attract users away from the higher efficacy (luminous output per unit of energy consumed) White and Warm White types. The higher the CRI the lower is the efficacy (i.e. lumens per watt of power consumed) of the lamp.

As a general recommendation, tubes should be selected with respect to the tasks as follows:

Task Illuminated	Lamp CRI
General office work and factory illumination	60-70
General inspection areas	>80
*Specific inspection areas	>90

*These tubes are recommended where it is extremely important to distinguish the colour characteristics of the meat, meat

contaminants or disease manifestations. However, their use should be confined only to the task areas where they are required.

Tubes which are highly efficient for colour rendering by comparison have less efficacy. That is to say, a lamp that is necessary to ensure that defects and diseases are detected because of faithful colour rendering of these elements to the inspector will be more costly to purchase and run because for a given light output (lumens) it consumes more power. Thus the expensive lamps with good colour rendering properties should be used only in small areas, e.g. inspection points, where good colour rendering is necessary, while the general lighting with higher efficacy over the large area may not have such good colour rendering properties.

In summary, the colour temperature gives an indication of the wavelengths of the most prominent emissions of a light source, i.e. the colour of the light the lamp produces. The CRI takes into account the emission of light over the visible spectrum and indicates how well the source emits over the whole range of visible wavelengths.

QUANTITY OF LIGHT (ILLUMINANCE)

This Newsletter has made reference to luminance (brightness measured with an instrument). Unfortunately, luminance cannot be measured with a normal light meter as the latter measures the amount of light falling on a surface (illuminance measured as lux). A luminance meter measures the brightness of an object as it appears in the field of view (reflected light). It is similar to a photographic exposure photometer used to measure reflected light but a luminance meter is calibrated in candelas per square meter (or foot lamberts in British units).

The recommended levels of illuminance in the new SAA code about to be published in 1976 are as follows:

Area	Illuminance
Inspection of product	600 lux (56 lm/sq.ft)
Preparation of product (other than slaughtering)	400 lux (37 lm/sq.ft)
Slaughtering	250 lux (23 lm/sq.ft)

It is important to remember that readings taken with a light meter should be taken in the plane of the object being examined as viewed by the operator and as close to the object as practicable. Hence a light meter reading on a meat carcass hanging on the slaughter line should be taken with the meter lying in the vertical plane of the carcass because it is the illuminance on the vertical sides of meat as seen by the operators that determines visibility.

In summary, the following general recommendations apply:

Task Illuminated	Colour Temperature	CRI	Illuminance
Inedible meat & meat products	3,500°K	60-70	200 lux
General inspection areas & meat hygiene checking	4,000°K - 4,500°K	>80	600 "
Specific inspection areas	4,000°K - 4,500°K	>90	600 "
Preparation of product (other than slaughtering)	4,000°K - 4,500°K	60-70	400 "
Slaughtering	4,000°K - 4,500°K	60-70	250 "

The next newsletter will discuss types of light sources.

ACKNOWLEDGMENT

This newsletter has been prepared from material supplied by:

Mr. M. O'Brien, Regional Engineer, Industrial Services Division, Department of Labour & National Service, New South Wales, and
Mr. J. Love, Chartered Engineer, Government Architects' Branch, State Department of Public Works, New South Wales.

The assistance of Mr. J. Shaw, CSIRO National Measurement Laboratory, is also acknowledged.

ABSTRACTS

Below are some abstracts of recent publications which may be of interest. Copies of publications are restricted to the Australian Mea Processing Industry and can be obtained by completing the attached form. Payment must be made in advance.

1. The De-Boning Debate. The M.R.I. discusses hot deboning exclusively for '*Meat*,' *49*, No.2, February 1976. 3p

Although the techniques of hot boning are still experimental, it is already apparent that hot boning could lead to considerable savings in cost and improvements in quality. Much of the experimental work into hot boning in the United Kingdom has been carried out by a few commercial companies and the Meat Research Institute of Langford, Bristol. In recent years the meat industry has explored two main variations to the standard practice of "bone-in primal cuts," and thes variations are described. However, the technique is far from fully developed, and the various factors to be considered are included in th article. Nevertheless, unlike many other radical techniques which hav been proposed for improving carcass utilization, reducing weight loss and drip, improving colour, increasing tenderness and its uniformity without long ageing periods, this technique appears to have substantia advantages which could in due course outweigh the disadvantages.

2. W.M. HILL, Microbiological Standards - Are They Realistic? *Food Product Development*, December 1975. 3p

Three methods are discussed to determine the acceptable or unacceptabl number of bacteria, when establishing the quality or safety of fresh c processed meats. The most logical is used by USDA, whereby under thei Federal Meat and Poultry Inspection Program a microbiologist-inspector team visits a large number of plants preparing the same type of meat product and, at various stages of manufacture, takes samples for microbiological analyses. This paper discusses three questions which arise when considering the use of microbial counts, of which the above is part answer to the first. The second concerns the coping of the regulatory agencies with the inevitable variation in bacterial counts between like products made under similar conditions, and the third ask what the consumer will get out of microbiological standards or guidelines for meats. All major meat processors operate under a blanket of microbiological specifications, either self-imposed or through agreement with other companies. One of the expected benefits of bacterial standards placed on meats at the retail level is public health protection. Using *E. coli* as an indicator of raw meat quality, particularly at low levels, is not easily justified, and the most probable number technique for obtaining *E. coli* counts is imperfect. As pointed out by FRI's Dr. J.M. Goepfert, establishing an *E. coli* standard of a finite number, analyzing by an imprecise method, and assessing criminal penalties for violations are untenable.

3. E.P. YOUNG, A.W. KOTULA & G.G. TWIGG, A Comparative Evaluation of Rapid Methods for Determining Fat Content of Ground Beef, *Journal of Animal Science, Vol.42*, No.1, 1976. 5p

Fat in 52 ground beef samples (5.9 kg) determined by the Anyl-ray, Univex, Hobart, Honeywell, Bligh and Dyer, and Soxhlet procedures, ranged between 15 and 32%. The mean fat content of all samples determined by Anyl-ray was 23.29%. The standard error for this method was not calculated because each sample was measured only once. Means of three observations per sample for the other methods in the order listed above were 23.14, 22.24, 23.81, 25.10 and 25.02%, respectively. The among-section error, which describes the nonhomogeneity within the 5.9 kg sample, as determined by fat analysis of subsamples selected from three different sections of the total sample and expressed as coefficient of variation ranged from 2.94 to 5.45%. The within-section errors for fat determinations by Bligh and Dyer and Soxhlet of subsamples from within the same sections were 2.92 and 3.42%, respectively. Correlation coefficients between methods ranged from .87 for Anyl-ray with Univex to .96 for Soxhlet with Bligh and Dyer.

Authors' Abstract

4. JOHN E. OWEN, JOHN HEWLETT & RALSTON A. LAWRIE, A Note on the Discoloration of Frozen Porcine Muscle, Stored under Fluorescent Illumination, as Influenced by an Artificially Induced High pH in the Meat, *J. Sci. Fd Agric.* 1976, *27*, 477-482. 6p

The effect of an artificially induced high ultimate pH (pH_u, measured at 24 h *post mortem*), on metmyoglobin formation in frozen porcine muscles was investigated. The muscles were exposed to white fluorescent illumination whilst under storage at -10°C. The results indicated that an artificially induced high pH was effective in retarding metmyoglobin formation in frozen muscles.

Authors' Abstract

5. Alcan Introduces New Rigid Foil Retortable System to Canadian Market, *Food in Canada*, December 1975. 2p

After some five years of development and exposure to the European processing industry and consumer market, Alcan is now introducing its rigid foil retortable system to the Canadian market. This concept offers the Canadian processor an opportunity to process a broad range of shelf-stable, high quality products. Major energy savings are also inherent in the employment of the system.

Editor's Abstract

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Meat Research News Letter

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Date 10th May 1976 **Number** 76/3

LIVER AND RUMEN CONDEMNATIONS FROM FEEDLOT CATTLE

High condemnation rates for livers and rumens from feedlot cattle represent a financial loss to the meat industry. In some cases the meatworks accepts the loss, but in other cases, if the condemnation rate is excessively and continuously high, the feedlot operator can be financially penalised.

LIVER CONDEMNATIONS

The most common reason for liver condemnation in feedlot cattle is the presence of abscesses (Figure 1) (other reasons include the presence of liver fluke, common in some areas of Australia). Liver abscesses are associated with the high energy, i.e. high grain, diets of feedlot cattle and common bacterium, *Sphaerophorus necrophorus*, is most often responsible. It is thought that acid damage to the rumen wall allows these bacteria access to the liver via the bloodstream.

RUMEN CONDEMNATIONS

The use of all-concentrate rations (i.e. no roughage rations) can lead to a condition called *rumen parakeratosis* (R.P.K.) (Figure 2).

Figure 1: A liver abscess ruptured into the peritoneal cavity.

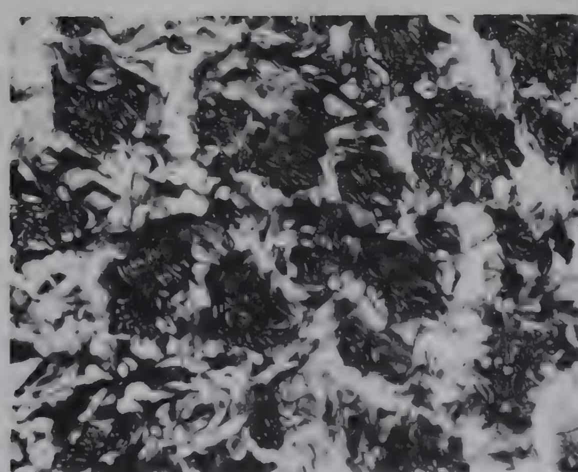

Figure 2: *Rumen parakeratosis* showing clumping of ruminal papillae.

(From Jensen, R., & Mackey, D.R., 'Diseases of Feedlot Cattle,' Lea & Febiger, Philadelphia [1965])

The symptoms are (1) a thickening of the rumen epithelium, which may also slough off, and (2) the rumen papillae (small fingerlike protuberances) which become firm, leathery, enlarged, and dark in colour. The papillae can slough off or clump together. In the rumen of cattle, fed all concentrate rations, considerable hair accumulation has been observed, which has been associated with R.P.K. The hair is found adhering to the papillae forming hair balls, and is related to the degree of sloughing and clumping of papillae. Rumens in this condition are difficult to clean, and are often rejected for the manufacture of edible tripe. In some abattoirs this rejection can mean an appreciable loss.

Liver abscesses can occur without R.P.K. Where R.P.K. does occur, however, the presence of liver abscesses is common. There is experimental evidence to show that cattle with liver abscesses have reduced liveweight gains. Extensive R.P.K. can interfere with the absorption of nutrients from the rumen.

R.P.K.

The R.P.K. problem is associated with all-concentrate feeding. Experimental evidence suggests that the addition of 10%-15% hay in the ration offers protection from R.P.K. and reduces the incidence of liver abscesses. The physical qualities of hay such as coarseness, bulkiness, and abrasiveness, may be necessary to maintain the integrity of the rumen wall, and finely chopped hay may not be sufficient to prevent R.P.K.

Cattle have been successfully fattened on all-concentrate rations without showing R.P.K. However, when grain has been finely comminuted, the incidence of R.P.K. has increased. This implies that grain fed in coarse form may assist in reducing the problem of rumen condemnations.

Some Darling Downs feedlots, who feed all concentrate rations, have dramatically decreased rumen rejection (due to R.P.K.) by including coarsely chopped hay in their ration for the final 10-14 days. This probably works by "cleaning" the rumen surface.

LIVER ABSCESSES

The problem of liver abscesses can be attacked on two fronts.

(a) Antibiotics such as chlortetracycline, oxytetracycline, and bacitracin are effective in reducing the incidence of liver abscess condemnation, in particular in all concentrate rations.

(b) Use of Roughage in feedlot rations appears to reduce the incidence of liver abscesses. Preliminary data from one Darling Downs feedlot indicates that when an all-concentrate ration was being used (and this included an antibiotic) liver condemnation rate was 24%. The inclusion of 6% coarse roughage throughout the feeding period has reduced the condemnation rate to 7%.

LIVER FLUKE (*Fasciola hepatica*)

This parasite is found in the bile-ducts of cattle. As the cause of "liver rot," and as an associative factor of black disease, it may cause severe losses in the field. It can also delay fattening and lessen milk yields. The parasite varies from yellowish-pink to greyish-brown in colour, and is leaflike in form, being broad in front and tapering behind. The liver fluke cannot be transmitted from one animal to another within the feedlot.

The life history is complicated. The eggs pass out in bile and faeces and, being sensitive to desiccation, can develop only when deposited in wet or marshy ground. From the egg hatches a microscopic free swimming form. Depending on temperature, this free life may extend from one to several days, and within this period it must find and enter a snail - not the common garden snail, but, in Australia, a smaller fresh water species. In the tissues of the snail the parasite transforms itself, escapes, and then attaches itself as a pinhead cyst to a piece of grass or other object at or about the water level.

Ingested by a suitable final host, the cyst is dissolved and the young fluke bores into the intestinal wall. Some young flukes may reach the liver *via* the bloodstream or by crawling up the bile-duct, but the usual route is *via* the peritoneal cavity after penetration of the bowel wall. Liver flukes are long lived, and may remain viable for years.

CONCLUSION

The problem of rumen and liver condemnations for R.P.K. and abscesses, respectively, is a complex one that has been aggravated by the use of all concentrate rations. The use of

roughage for the final 10-14 days will reduce the R.P.K. problem but not liver abscesses. To reduce liver abscesses, roughage would be required for the whole fattening period. An antiobiotic fed as a daily supplement at low level may also assist.

Feedback of information from the meatworks to the supplier concerning these conditions should be encouraged. It must be emphasised, however, that no practicable form of treatment or feeding can be guaranteed to eliminate either condition - particularly liver abscesses. Moreover, it has been observed that different mobs of cattle, from the same feedlot and receiving the same treatment, can have a markedly different incidence of liver abscess. While the cost of condemnation can be substantial, changing the diet by inclusion of roughage may not be an economic proposition. Consequently, if the incidence of liver abscess or R.P.K. is high, any remedial action must depend on the particular circumstances.

Where liver fluke damage leads to liver condemnation, the feedlot operator should be informed and advised to seek assistance.

State Departments of Agriculture or Primary Industries should be consulted.

ACKNOWLEDGMENT

This Newsletter was prepared from information supplied by Mr. A.W. Plasto, Senior Husbandry Officer, Beef Cattle Husbandry Branch, Department of Primary Industries, Toowoomba, Queensland.

ABSTRACTS

Below are some abstracts of recent publications which may be o interest. Copies of publications are restricted to the Australian Meat Processing Industry and can be obtained by completing the attached form. Payment must be made in advance.

1. I.A. DYER, E. RIQUELME, L. BARIBO & B.Y. COUCH, Waste Cellulose as an Energy Source for Animal Protein Production, *World Animal Review* 15, 1975. 5p

The feeding of high proportions of grain to fattening cattle needs to be reevaluated in view of the prevailing low world food reserves and the low availability and high cost of feed grains. The potential of cellulose as an energy source and the utilization of unprocessed cellulosic feeds in limited amounts by ruminant animals have been known for many years and are discussed in several texts. Domestic animals generally compete with man for cereal grains and i is not economically feasible for the relatively inefficient ruminan animals to compete with the more efficient non-ruminants and man fo high cost grains. Researchers, aware of the problems, have utilize forages and cellulosic waste, derived from agriculture and other sources, primarily to provide roughage in finishing cattle rations. In order to increase the utilization of straw, hay and other cellulosic materials and make them acceptable as a primary energy source of ruminants, several processes have been investigated. Beckmann (1922) reported that treating straw with a 1.5% NaOH solution resulted in a twofold increase in the amount of crude fibr utilized by ruminant animals. Butterbaugh and Johnson (1974) compared the nutritive value of rations containing acid hydrolyzed wood residue with that of alfalfa meal in lamb fattening rations. Utilization of high acid hydrolyzed wood residue (2.3% H_2SO_4), however, was limited by palatability if fed at levels higher than 35% of the ration and weight gains were decreased even at the 20% level. Other advantages of using waste cellulose for animal protei production are that most people eat meat when it is available and that animal protein is of higher biological value than most plant proteins. Furthermore, beef cattle, sheep and goats are already adapted to most inhabited areas, and cellulosic waste, although not evenly distributed, occurs in most populated parts of the world.

2. J.A. STOTT, J.E. HODGSON & JANE C. CHANEY, Incidence of Salmonellae in Animal Feed and the Effect of Pelleting on Content of Enterobacteriaceae, *J. Appl. Bact.* 1975, 35, 41-46. 6p

During a survey of meat and bone meals, fish meals and poultry feeds, salmonellae were found only in samples of meat and bone meal for which 19% were *Salmonella*-positive. Most probable number estimations on two meat and bone meal samples gave figures of 6 and 39 salmonellae/100 g respectively. Sampling of poultry feed before and after pelleting showed that this process gave up to 1000-fold reduction in numbers of Enterobacteriaceae, depending on the type o processing involved.

Authors' Abstrac

3. GRAEME MOSS, Noise and the Law, *Australian Refrigeration*, Vol.30, No.1, January 1976. 5p

The worldwide movement to provide protection of the environment in which we work and play and rest has been somewhat slow to introduce effective noise control legislation. It has been found most difficult to frame legislation around noise control. A major difficulty is the subjective nature of noise. What may be a pleasant and enjoyable sound to one person may well be an annoying noise to another. Furthermore, subjective response to sounds is very different during the middle of the night when the background noise level is very low, compared with during the day when the background noise from traffic has increased.

The transient nature of noise introduces a further complication. Noise gives rise to no residue following its emission whereas in most other areas of pollution, traces of the pollutant may still be found in the environment long after the emission has ceased. Also the noise level will vary according to the distance between the source and the receiver, and with the extent of any interposing barriers or reflecting surfaces. The character of the noise, such as its frequency distribution, its impulsiveness or its duration further influences the subjective reaction.

Attempts to resolve these various factors in any legislation specifying mandatory noise level criteria have encountered major problems related to the differences between the respective political, legal and scientific requirements.

Author's Abstract

4. J.H. HODGES, V.R. CAHILL & H.W. OCKERMAN, Effect of Vacuum Packaging on Weight Loss, Microbial Growth and Palatability of Fresh Beef Wholesale Cuts, *J. Food Sci.* 39, 143-146 (1974). 4p

Carcasses of high and low quality grade were held for 1 and 15 days postmortem prior to cutting, sampling and packaging. Wholesale cuts were packaged under vacuum and stored for 28 days. Weight loss determination, aerobic and anaerobic bacterial counts and taste panel evaluations were made at various storage intervals. Purge losses were different for wholesale cuts. Increased prepackage holding time and time in vacuum storage increased both aerobic and anaerobic bacterial counts. Tenderness increased during 15 days holding period and during vacuum storage of product packaged one day postmortem. General acceptability scores followed tenderness scores except for the low grade, 15-day postmortem packaging sample which was given an unfavorable rating due to off-flavor.

Authors' Abstract

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Date 19th July 1976 **Number** 76/4

GRASS SEEDS

Infestation of sheep and lambs with grass seeds causes economic loss and inconvenience to both meat processors and graziers. In meatworks, heavy infestation means extra labour to trim affected carcasses, capital tied up in trimming facilities, downgrading of trimmed carcasses due to appearance, loss of value of skin, loss of meat yield because of trimming, and increased possibility of rejection overseas due to seeds being left in export meat.

Farmers have to bear most of these costs, as well as the direct loss due to loss of liveweight as a result of seed infestation, and death of stock through seed induced bacterial infection.

An understanding of the cause of the grass seed problem, together with good husbandry practices, can do much to alleviate grass seed infestation in many parts of Australia.

There appear to be considerable differences in grass seed problems of different parts of Australia. In the tropics and subtropics, where grasses seed after a Summer growing period, the problem is very different from that in cooler Winter rainfall areas, where the grasses seed in Spring before the dry Summer period.

In *Queensland* the main grasses producing seed which affect sheep are the wire and white Spear grasses (*Aristida* species), and black or bunch Spear grasses (*Heteropogon contortus*). When the seed has matured and dropped, sheep are less likely to become infested. However, in sheep infested with the seed (i.e. where the seed has entered the skin and deeper tissues) infestation with black Spear and white Spear grass seeds persists for years. In one trial in Queensland the seed persisted for the duration (four years) of the trial. During the four year period the number of seed per sheep decreased from over one thousand to a few hundred.

This Newsletter has been written with the *Winter rainfall*, Spring seeding, situation in mind.

With the exception of the tropical and subtropical situations mentioned above, in Winter rainfall areas the worst time of year for grass seed infestation is October and November. At this time of year, seed heads are ripening, and as stock graze the grasses are disturbed, causing the seed to drop onto the fleece. Movement of the sheep causes the seeds to work their way through the wool to the skin. The seeds may continue to work through the skin or eyes, and come to rest usually in the subcutaneous tissue, but sometimes also deep within muscle tissue and internal organs.

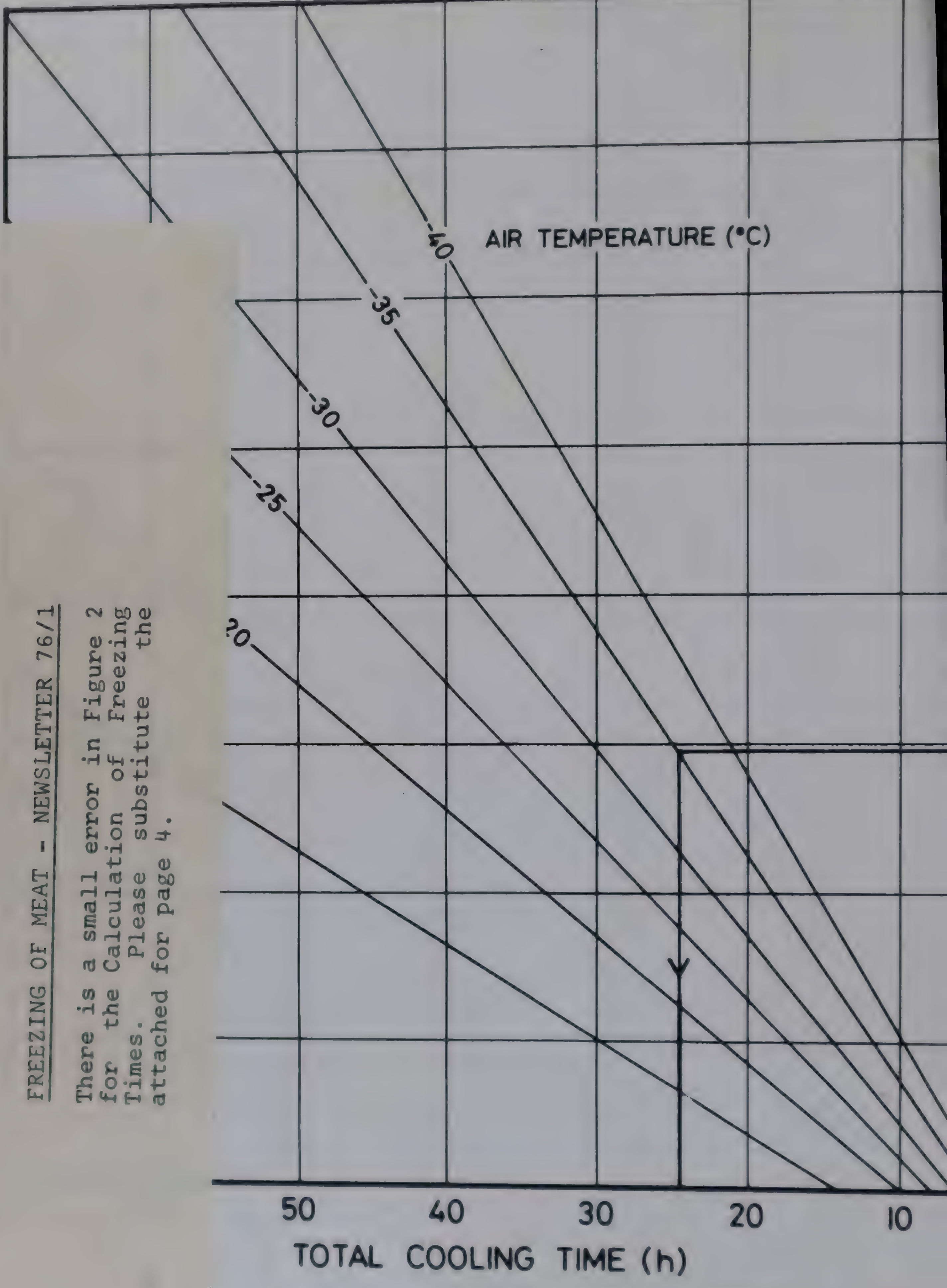
Barley grass (*Hordium* spp.), Spear grass (*Stipa* spp.), Crowfoot (*Erodium* spp.), Wire grass (*Aristida* spp.), and Silver grass (*Festuca* spp.) are responsible for seed infestation. Seeds from these grasses are a problem because they are awned. The awn is a sharp projection of the seed coat, which provides the means of penetration through the skin.

When the seed drop is complete, the number of seeds in sheep skins and tissues decreases. It is not known if this occurs because seeds are rejected, encysted, or if some other physiological process eliminates seeds from the sheep.

Graziers should be aware that stock can lose liveweight when infested with grass seeds; adult wethers can lose up to 10 kg liveweight in late Spring. The weight loss occurs because sheep and lambs are reluctant to move around in the seedy pasture. It is not known if the stock are reluctant to move through the pasture because of the pain from seeds already buried in the skin, or if they are aware that further grazing in that pasture will increase the level of infestation and increase their discomfort.

FREEZING OF MEAT - NEWSLETTER 76/1

There is a small error in Figure 2 for the Calculation of Freezing Times. Please substitute the attached for page 4.



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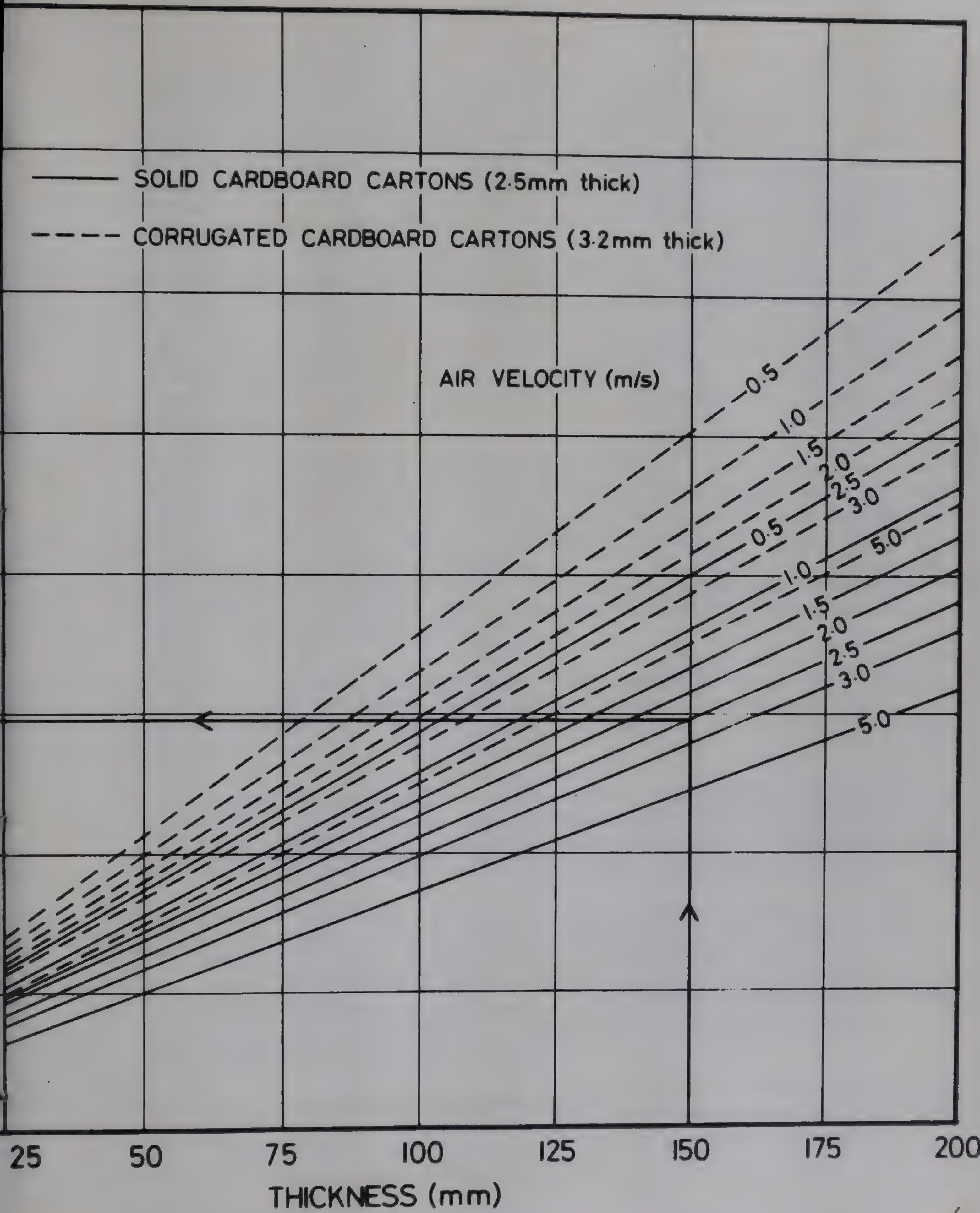

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ON COOLING TIME WHEN

Where possible, sheep should be moved from the awned seed grasses prior to the seed drop and onto other suitable pastures, e.g. lucerne and the improved rye species. It is recognized, however, that alternative pastures may not be available. Lambs in particular should be moved away from the grass seed hazard. Apart from the fact that greater economic loss is suffered from an affected lamb carcass compared with a mutton carcass, lambs are more prone to grass seed infestation. This could be due to one of several reasons, or even a combination of reasons. Firstly, lamb's skin is more tender than sheep's skin, and seeds may be able to penetrate more readily. Secondly, lambs are closer to the ground than sheep, and could pick up more seeds in the fleece. Thirdly, the greater experience of sheep could induce a tendency to avoid the grass seeds.

The correlation between aspects of the pasture architecture such as seed height and seed head density, and the incidence of grass seed infestation, is being studied. When more is known about this relationship it will be possible to produce a pasture architecture which minimizes seed infestation of grazing stock with improved grazing management. Heavy stocking tends to prevent seeding, so lessens the trouble.

Where sheep and lambs must be grazed on pasture likely to give rise to grass seed infestation, the following precautions should be observed to reduce the level of infestation.

1. Shear sheep early in the Spring to reduce the grass seed infestation. Shorn sheep are less susceptible to grass seeds than unshorn sheep, because there is less wool to catch the seeds as they drop from the plant.

2. Run horses and cattle in badly seeded pasture. The horses and cattle will graze it down and cause the seed to drop. Similarly, the seed can be induced to fall by dragging brush harrows, such as a length of chain between two tractors, through the pasture. This is not often practicable, but it is particularly effective against *Aristida*.

3. Mow wide tracks through the pasture to dams, tanks and sheep's camping places. This allows the stock to move around freely without the risk of picking up grass seeds.

If sheep and lambs must be grazed on barley grass, the threat of grass seed infestation can be reduced by good grazing management. Heavy grazing of the pasture, up to 50 head per hectare, in late Winter (mid July to end of August), will reduce the height of the seedhead and prolong the period before pasture maturity occurs. If the seed sets closer to the ground, it is less likely to penetrate grazing sheep. Grazing the pasture in this manner would prepare it for ewes and lambs in late Spring. If allowed about three weeks to recover (under adequate rainfall), although the pasture will not be so abundant, and lamb growth rates may fall short of the maximum, the lambs *will* be relatively seed free and will gain weight more readily than lambs infested with grass seeds.

In summary, the most effective way of reducing grass seed infestation of sheep and lamb carcasses is to move grazing stock off the pastures causing the seed infestation. Furthermore, if the seeds in the carcass are identified, suppliers of seedy sheep could be advised of the particular pasture causing the problem. It would also assist future prevention work to establish which seeds cause the most infestation. Any meatworks wishing to identify the types of seeds in carcasses should approach the *Department of Agriculture or Department of Primary Industries local Sheep and Wool Extension Officer for assistance.* Graziers should also, of course, seek assistance from these Authorities.

Additional supplies of this Newsletter are available to those works wishing to send them to clients found to have seedy sheep.

ACKNOWLEDGMENT

Prepared from material supplied by, and with the assistance of, Mr. John Thompson, Mr. Dave Michalk and Mr. Geoff Warr, Trangie Agricultural Research Station. The assistance of the Department of Primary Industries, Queensland, is also acknowledged.

ABSTRACTS

Below are some abstracts of recent publications which may be o interest. Copies of publications are restricted to the Australian Meat Processing Industry and can be obtained by completing the attached form. Payment must be made in advance.

1. C.O. GILL, N. PENNEY & P.M. NOTTINGHAM, Effect of Delayed Evisceration on the Microbial Quality of Meat, *Applied and Environmental Microbiology 31*, April 1976, No.4. 4p

The postmortem invasion of muscle and other tissues by bacteria fro the intestinal tract was studied with the use of radioactive tracers. The injection of ^{14}C-labeled bacteria or spores into the intestines of guinea pig carcasses within 24 h or death resulted in the rapid spread of ^{14}C throughout the carcasses. When live bacteri were injected along with the labeled cells, it was not possible to isolate viable organisms from the body tissues if the living animal had been exposed to the bacteria. It appears that animals are immune to their normal intestinal flora and that this immunity persists after death; thus passage of these bacteria into the lymphatic system does not necessarily result in the presence of liv bacteria in carcass tissues. It therefore seems that a delay of up to 24 h before evisceration would not lead to deep tissue contamination of the carcass by organisms usually present in the intestines. Further evidence for this hypothesis was obtained by showing that muscle and lymph nodes from uneviscerated lamb carcasses hung for 24 h at 20°C remained sterile. Authors' Abstrac

2. H. ALLAN BREMNER, Batch Dry Rendering: the Influence of Controlled Processing Conditions on the Quality of Meat Meal Prepared from Sheep Stomachs, *Journal of the Science of Food an Agriculture 27*, No.4, April 1976. 8p

A series of meat meals was prepared from the one type of offal material, sheep stomachs, by batch dry rendering in a model cooker. The meals, designated normal cook (NC), overcooked (OC), rapidly cooked (RC), normal cook with added glucose (GC) and spoilt offal cook (SC), were evaluated as protein supplements by chick growth tests in rations based on wheat and skim milk powder. A control ration (CR) and one incorporating a commercial meat and bone meal (MR), were also included for comparison. No significant difference in weight gain were evident within replicate batches or between treatments NC, GC, OC and RC. Feed conversion ration (FCR) did not differ significantly within replicate batches NC, OC and RC. A low weight gain and high FCR was given by SC. Weight gain did not vary significantly with feed intake.

A significantly higher weight gain and lower FCR was given by CR whilst the lowest weight gain and highest FCR were given by MR, whose results were comparable only with meal from spoilt offal. Available lysine values (ALV) did not show significant decrease in the OC batches, but were lower in the GC batches. These results

show that the nutritional value of meat meal is not adversely affected by varying the time of cooking from 1 to 2¼ h, by severe overprocessing or by addition of glucose, but that gross spoilage will decrease the nutritive value.

Author's Abstract

3. New Process Puts Paunch Wastes to Efficient Use as Cattle Feed, *The National Provisioner*, April 3, 1976. 3p

A new process for paunch content disposal, developed by Corral Industries, Inc., Phoenix, Arizona, now is being utilized by Dumas Cattle Feeders, Dumas, Texas. At this feedlot, paunch wastes from the nearby beef dressing plant are recycled into cattle feed. The system is described, together with the various items of equipment used - a hopper, equipment complex mounted on a trailer, Corral press. The technique is a two-stage chemical treatment process. Previous feed trials conducted by Corral Industries indicate that the cattle will accept and gain on rations containing a high percentage of treated paunch solids. The feed ration is then detailed. The feed test at the Dumas Cattle Feeders lot is scheduled to run for several additional months to permit the evaluation of data on feed conversion efficiency and rate of gain using the paunch-derived feed.

4. D.M. LUCAS, J.P. FONTENOT & K.E. WEBB, Composition and Digestibility of Cattle Fecal Waste, *Journal of Animal Science 41*, No.5, 1975. 7p

Three digestion trials were conducted with six yearling steers to study the apparent digestibility of fecal waste from steers fed a ground, high roughage finishing ration. In the first trial the steers were fed a basal ration containing approximately 50% roughage. The feces collected during this trial were dried in a forced-air oven at 120°C and ground. The chemical composition of the feces was 13.2% crude protein, 31.4% crude fiber, 2.8% ether extract, 5.4% ash, 47.2% NFE, 70.9% cell walls and 44.8% ADF, dry basis. During trials 2 and 3 a switch-back design was used to study *in vivo* digestibility of the cattle fecal waste, which was substituted for 20% of the basal ration. Apparent digestibility of dry matter was 68.2% for the basal ration and 57.4% for the ration in which 20% dry fecal waste had been substituted ($P<.01$). There were also large depressions ($P<.01$) in apparent digestibility of organic matter, crude protein, crude fiber, ether extract, NFE, cell solubles, cell walls, ADF, cellulose, hemicellulose and energy when dried fecal waste was included in the ration. Apparent digestibilities of fecal waste crude protein and dry matter, calculated by difference, were 24.4 and 16.6%, respectively. The dried fecal waste contained 763 kcal digestible energy and 485 kcal of metabolizable energy per kilogram of dry matter. *In vitro* dry matter digestibility of the fecal waste was 15.8%. It appears that dried fecal waste from cattle fed a 50% roughage ration has limited protein and energy value.

(Key Words: Cattle Waste, Fecal Waste, Digestibility, Animal Waste)

Authors' Abstract

5. A.N. BHATTACHARYA & J.C. TAYLOR, Recycling Animal Waste as a Feedstuff: A Review, *Journal of Animal Science 41*, No.5, 1975. 20p

The solid waste from farm animals in the United States is estimated at two billion tons annually. It is also estimated that 50% of this waste is produced by intensive animal production systems. The disposal of animal waste onto the land has been the traditional practice of the animal industry. This practice remained attractive for a long time because of the benefit of maintaining soil fertility, securing a convenient channel of manure disposal and harvesting nutrients in food and feed crops. In recent years, the problems of animal waste disposal in concentrated areas has been augmented by confined feeding operations, and limited land for disposal of large tonnages of waste. In addition, increased public consciousness of environmental pollution has challenged the animal scientists and others to expand and to improve the disposal system, recycling the waste nutrients most effectively wherever feasible. The economic evaluation of animal waste management is difficult. From the standpoint of cost and return however, the handling and disposing of animal waste for crop production has been economically handicapped by the relative convenience and availability of low cost inorganic fertilizers.

For this reason, together with the increasing demand for feedstuffs, the possibility of reclaiming the nutrients contained in animals' wastes for animal production purposes has been extensively investigated as alternate sources of feed. In the past, research in this field has been devoted primarily to the evaluation of the nutritional value of livestock and poultry wastes. The U.S. Food and Drug Administration has expressed concern over the potential for animal and human health hazards which may result from the use of these types of products as animal feeds. Accordingly, studies have been conducted and others are planned which have been designed to establish the safety of processed animal wastes to animal and man.

This review summarizes the available information on: (1) the nutritional value of different kinds of animal wastes as feed for livestock and poultry; (2) the identity of possible agents which may cause human and animal health hazards; and (3) the effect of processing methods on the safety of such animal waste feed.

Authors' Abstract

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Date 1st November 1976 **Number** 76/6

INDUSTRIAL LIGHTING IN MEAT PROCESSING PLANTS

LIGHT SOURCES

This Newsletter is companion to Meat Research Newsletter 76/5 and is intended to assist management in decision making in selecting light sources and fittings in meat processing plants.

There are three principal types of light source commercially available, with variations within each type.

INCANDESCENT LAMPS

These lamps generally have a Tungsten filament heated in Argon gas to a colour temperature of 2,700-2,900°K, and emit a pleasant yellowish light.

They are ideal for domestic and decorative lighting, and are relatively cheap, but they have some disadvantages for commercial operation. These disadvantages are:

i) Short life. Generally about 1,000 hours, i.e. only seven weeks of continuous burning.

ii) Most of the energy input to the lamp is converted to heat, which, coupled with the relatively low luminous output, means that these lamps can cause a substantial addition to the heat gain of the building. This can be a serious disadvantage in cold rooms.

iii) Low luminous output per unit of energy consumed. Incandescent lamps produce approximately 11 to 12 lumens/watt.

iv) Bright point source. As the light generated is a point source, the brightness is high; this is often alleviated with etched or silica coated lamps.

Fittings for incandescent lamps are probably cheaper than for other lamps and there is no associated control equipment, e.g. chokes, ballasts, capacitors, but for commercial operations the cost of electrical energy and maintenance would become excessive and the additional heat load on air conditioning would also increase electricity consumption. Incandescent lamps, however, can be used in little used areas such as storerooms and cleaners' cupboards.

TUBULAR FLUORESCENT LAMPS

In the fluorescent tube, current flowing between heated electrodes ionises a path through mercury vapour contained in Argon gas down the length of the tube. The ions cause the tube's inner coating of phosphor to become activated. These phosphors give the lamp its characteristics, particularly the colour. Manufacturers are able to market various types of lamps, with different phosphors, often under various names. If colour temperature is known, the most suitable type of lamp can be ordered. 3,500°K tubes are usually best for office and general lighting.

For abattoirs, in areas where edible meat is processed, 4,300°K tubes are often more suitable. The difference between these tubes is apparent only if the two are viewed together.

Where colour is important, such as for colour matching in the textile industry, tubes with a colour temperature of 6,500°K - "daylight" tubes - are used. Improved types of these tubes, called "colour corrected tubes," are used in anaesthetic rooms in hospitals, where colour is of vital importance. Colour temperature of 3,500-5,000°K are generally used in hospitals.

For use in abattoirs, however, tubes with a colour temperature of 4,300°K are the best compromise. They are cheap, and the luminous output can reach 60 lumens/watt. The 6,500°K tubes have an output of about 40 lumens/watt, indicating that on grounds of economy their use should be limited to special purpose lighting.

Comparison of fluorescent with incandescent lamps shows:

i) Long life. Generally about 6,000 hours (although 7,500 is often obtained) compared to the 1,000 hours of an incandescent lamp.

ii) High luminous output. As already stated, this can be up to 60 lumens/watt. In other words, fluorescent fixtures give 3½ to 5 times more luminous output than incandescent fixtures for the same consumption of electrical energy.

iii) Lower source brightness. Since the light is emitted from a large area, the brightness of the source is far less than with the small incandescent source.

DISCHARGE LAMPS

In these lamps an arc is struck between electrodes enclosed in a translucent tube (often quartz) which contains either Mercury or Sodium vapour.

The arc must be struck and heat generated before the mercury or sodium becomes vapourised. The arc which discharges through this vapour emits the light. These lamps are called "Mercury Vapour Lamps" or "Sodium Vapour Lamps."

i) MERCURY VAPOUR LAMPS

Mercury Vapour Lamps emit mainly blue light and are often used for street lighting and similar applications. Most motorists will be familiar with the characteristic blue light of the mercury lamp. However, mercury vapour lamps are also available where the outer envelope is coated with phosphor that produces a reddish light. Colour temperature is not particularly meaningful with these "colour corrected" lamps because the energy emissions are uneven. Mercury vapour lamps, which are "colour corrected" lamps, generally have poorer colour rendering indices than fluorescent lamps. These lamps are available in small sizes, as low as 40 watt, although 125 watt sizes and 400 watt are the most common.

ii) SODIUM VAPOUR LAMPS

Sodium Vapour Lamps emit a yellowish light and can be used for street lighting. The motorist should also be familiar with the yellow light of the sodium lamp. The development of the high pressure sodium vapour lamp is of considerable interest, because the light is far less yellow and has more of a golden colour.

The light from a Sodium Vapour Lamp is mainly monochromatic and therefore consists of visible light of one frequency only (5,890-5,896 Angstrom units). Because the light reflected from an object is affected by the colour of the light falling on it, the red/yellow colours will be accentuated by these high pressure lamps. The main attraction of the sodium vapour lamp is its very high luminous output of 100 lumens/watt - nearly double that of fluorescent or mercury vapour lamps, and nearly 10 times that of incandescent lamps.

The characteristics of discharge lamps are:

a) Lamp life is generally 7,500 burning hours, although 12,000 hours is obtainable with specific types.

b) All discharge lamps require current limiting chokes, which add to the heat produced.

c) Luminous output. Mercury Vapour Lamps produce approximately 60 lumens/watt and Sodium Vapour Lamps produce approximately 100 lumens/watt.

d) Bright point source. Both lamps are very bright at the source, because the arc is only a couple of inches long and is therefore almost a point source. The lamps should either be mounted high above the working plane, about 18 feet above floor level, or shielded.

iii) MERCURY BLENDED LAMPS

Discharge lamps require some means of limiting the current of the arc, and for the types already described, this is done with an inductive coil (choke). However, it is possible to use the resistance of a Tungsten filament to limit the current, and to contribute to the light output. Thus both mercury discharge and incandescent capabilities are built into the same globe: hence the name "Mercury Blended." The advantage of these lamps is that they do not require external ballasts, and therefore can be inserted in a bayonet holder. The luminous output is not much better than incandescent, at 12 lumens/watt, but the advantage lies in the long life of some 6,000-7,000 hours of burning, which eases the maintenance problem.

GENERAL

Condensation of moisture in an abattoir can be a problem, since it is inherently corrosive and will take its toll of the ordinary type of industrial fittings in a relatively short time. This directs the choice of fittings to those classed as corrosion resistant and waterproof. Compliance with the regulations requiring the lamps to be contained within an enclosure is generally met by most proprietary manufacturers' fittings.

Where there is the opportunity to plan a new installation, the use of recessed lighting fittings, with all plant services in the ceiling void, is best for efficient cleaning and maintenance.

Where an existing installation is to be upgraded, incandescent lighting could be removed and replaced with fluorescent or discharge lighting. Obviously, from the luminous output figures given previously, illumination can be substantially increased without an increase, or maintained with a decrease, in electricity consumption.

The cleaning of light fittings is probably one of the major headaches for the maintenance department. Fittings should be selected for ease of cleaning and ready access. Bay fittings may be placed high, partly to avoid condensation, but this is countered by the difficulty of access.

In the replacement of lamps, the major cost is the labour rather than the cost of the lamp. Therefore it is more economical to change all the lamps in a particular area at the same time. For fluorescent tubes, this could be after, say, 6,000 hours of burning or every 18 months. Any loss from the discard of tubes that are still functioning is more than compensated by the saving in labour. In addition, the luminous output of a lamp decreases during its life, and replacement of the lamp at a chosen time avoids deterioration of the standard of lighting.

When an installation is to be upgraded the selection of type of light source, the quality of fittings and the permanence of the installation, depend very much upon forward planning by management. It would be very wasteful to install expensive light fittings if the building is to be made redundant in two or three years, or to install cheap fittings in a building which is going to remain unaltered for the next 20 years.

ACKNOWLEDGMENT

This Newsletter has been prepared from material supplied by:

Mr. M. O'Brien, Regional Engineer, Industrial Services Division, Department of Labour & National Service, New South Wales, and

Mr. J. Love, Chartered Engineer, Government Architects' Branch, State Department of Public Works, New South Wales.

The assistance of Mr. J. Shaw, CSIRO National Measurement Laboratory, is also acknowledged.

ERRATUM: Newsletter 76/5, page 6, paragraph 4, second line.

Please read "Natural" for "National."

ABSTRACTS

Below are some abstracts of recent publications which may be of interest. Copies of publications are restricted to the Australian Meat Processing Industry and can be obtained by completing the attached form. Payment must be made in advance:

1. A Review of Microwaves for Food Processing - A.J.H. SALE. *J. Fd Fechnol.* (1976) *11*, 319-329. 11p

Ideas for the application of microwave heating to the processing of food are reviewed. A selection has been made of ideas for pasteurizing, sterilizing, defrosting, dehydrating, cooking and other applications that are described in the literature. Several are discussed to illustrate particular aspects and characteristics of microwave processing, and to try and show some reasons for the successes and failures.

Microwave heating on its own has led to few commercially successful processes; however, when combined with conventional sources of heat, microwave heating appears to have greater potential, and has led to several successful processes.

2. Ways and Means of Improving Yield of Fresh Produce in Chillers - K. VISSER & A.M. AIRAH. *Australian Refrigeration, Air Conditioning and Heating*, August 1976, 22-29 & 59. 9p

The phenomenon of weight loss is examined and methods of controlling the relevant quantities such as humidity, air velocity, rate of cooling down, coil temperature differences, etc., is reviewed for such products as meat, fruits and vegetables. The application of hydrocooling, vacuum cooling, ice and air blast cooling, in bulk and fluidised form is considered.

The effects of weight loss on product appearance, quality and resulting saleability is discussed as is increased profit due to higher quality and higher yield. Some practical illustrations are given of coil temperature difference control by means of back pressure regulators and coil capacity control independent of compressor capacity itself varying with changing ambient conditions. The two aspects of moisture removal from air passing over a cooling coil is examined in the light of temperature difference, air quantity and varying heat transfer rates for dry, wet and frosted coils, in which dry coils during normal operation are of special significance.

3. Reducing Corrosion Through Design - *Food in Canada*, December 1975, 22-24. 3p

The conventional approach by designers and architects toward the problem of corrosion has been primarily through the specification of corrosion resistant materials, which has frequently overlooked design techniques that avoid or control corrosion. Anticorrosion design measures are particularly important since remedial action during the design stage has a minimum overall expense, whereas changes at a later date can result in prohibitive costs.

4. Microbiological Criteria for Food in Military and Federal Specifications - EDMUND M. POWERS. *J. Milk Food Technol.* 38, No.1, 55-58. 4p

Microbiological criteria in military and federal food specifications are presented. Approximately 10% of more than 600 specifications for food contain microbiological requirements which are applied in procurement of food for military and federal agencies. Foods were grouped into four categories which include dehydrated foods, milk and milk products, miscellaneous dairy products, and frozen foods. Microbiological requirements vary with the food item and include criteria for the aerobic plate count, coliforms, *Escherichia coli*, salmonellae, yeast and mold, proteolytic bacteria, lipolytic bacteria, psychrotrophs and direct microscopic count. Specifications may be obtained by writing to the U.S. Naval Publications and Forms Center, NPFC Code 1032, 5801 Tabor Avenue, Philadelphia, Pennsylvania 19130.

5. Effluent and Wastes from the Meat Industry - H. HALL & D.H. GOUGH. *Meat*, June 1976, 24, 27, 29 & 30. 4p

There have been a number of papers dealing with the treatment of effluents and wastes from the meat industry and it is difficult to avoid repetition of established facts in this article. It does, however, set out to examine areas where worthwhile economies seem possible in the face of the relentless escalation of costs for power, fuel, inspection services, potable water and effluent disposal.

Wastes from the meat industry are mainly natural organic matter and are generally free from substances which could inhibit the normal processes of sewage purification. They comprise: urine, faeces, the partially digested paunch and gut contents, blood, serum, washings from carcasses, floors, storage containers, tools and utensils, particles of meat from cutting and boning operations, condensates from rendering offal, waste liquors from byproducts manufacture and, where meat processing is carried out, wastes from preparation and cooking, vegetable products, wastes from curing and pickling, together with cleaning chemicals and detergents.

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Date 21st January 1977 **Number** 77/1

STORAGE TEMPERATURES FOR FROZEN MEATS

THE PROBLEM OF TIME AND TEMPERATURE

How long can meat be kept in frozen storage without noticeable loss in quality? Although there is no clearcut answer to this question, frozen meats do deteriorate during storage, and under some conditions the changes can result in severe economic loss. Changes during storage are slow and progressive and deterioration is not sudden. Very slight changes in flavour are sometimes difficult to detect, and are unimportant for some markets. For other markets, however, even slight off-flavours are regarded seriously.

Flavour deterioration due to oxidation of fats usually limits the storage life of frozen meats because oxidation leads to rancidity. Meats which contain a high proportion of unsaturated fats (e.g. pork) are more susceptible to rancidity than meats such as beef, lamb and mutton which contain mostly saturated fats.

Oxidation can be retarded by using oxygen impermeable wraps and low storage temperatures. Development of rancidity in frozen meat is accelerated by the presence of salts, contamination of fat with muscle pigments or blood pigments, or by cooking.

Stability during storage therefore depends on several factors, especially temperature. The graph (on page 3) summarises a great deal of published information about the effects of temperature on frozen foods, and should help *you* decide the storage conditions which will protect *your* products against deterioration.

The graph shows the approximate relationship between the rate of deterioration and temperature for some frozen meats. Every position on the graph represents a combination of time and temperature. All points below and to the left of the curved lines represent time/temperature combinations which should be safe. Conversely, those above and to the right of the curves describe combinations for which detectable deterioration and perhaps economic loss are to be expected.

TO FIND SATISFACTORY STORAGE TEMPERATURES

(1) Decide the maximum period for which storage is likely to be needed.

(2) Decide how much deterioration you can permit.

(3) Draw a vertical line from selected storage period on the base to meet the curved line appropriate to your product and the *Maximum Permissible Storage Temperature* is given by the horizontal line intersecting the curve at this point.

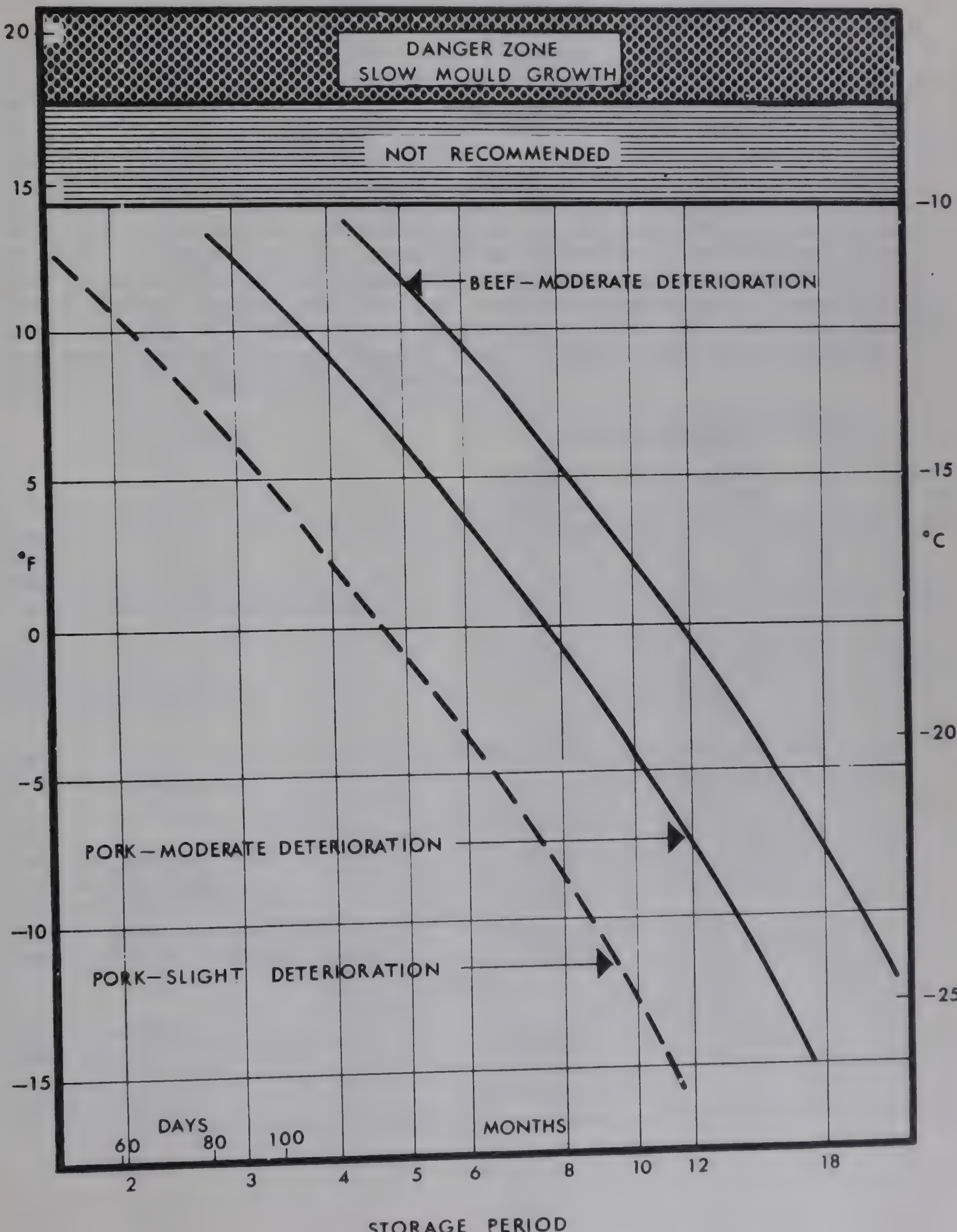
TO FIND SATISFACTORY STORAGE TIMES

(a) Draw a horizontal line for the temperature in your store until it intersects the curve for the product and permitted level of change.

(b) The vertical line from this intersection then gives the *Maximum Safe Storage Period*.

The lower the storage temperature, the longer will be the storage life of the product. The use of lower temperatures is gaining acceptance overseas, and -18°C (0°F) *is being widely adopted*. This trend to lower temperatures is expected to influence the future design of freezer stores. Domestic freezer temperatures are generally in the range -18°C to -9°C (0 F to 15°).

RELATION BETWEEN TEMPERATURE
AND STORAGE PERIOD OF MEAT



PRACTICAL STORAGE LIFE OF SOME FROZEN MEAT PRODUCTS

The table below gives the practical storage life at three different temperatures for some products, which have been processed and packaged according to good commercial practice and maintained at a reasonably steady temperature. Exceptionally good packaging (particularly the use of films impermeable to oxygen) or the use of antioxidants or protective barriers (such as covering with sauce, crumb, gravy, etc.), may extend the storage life. On the other hand, the use of poor quality raw materials, defective processing or packaging, or a fluctuating storage temperature can considerably reduce the storage life. The figures should be regarded as an approximate guide and are those quoted by two recognised world authorities - International Institute of Refrigeration (Recommendations for the Processing and Handling of Frozen Foods, 1964 & 1972) and, in brackets, Ashrae (1974 Application Handbook):

Product	Storage Life in Months				
	-12°C 10°F		-18°C 0°F		-25°C -13°F
Beef	5-8	(4-12)	12	(6-18)	18
Roasts, Steaks			12		18
Ground Meat, unsalted	5-6	(3-4)	10	(4-6)	>12
Veal		(3-4)	9	(4-14)	12
Roasts, Chops			9		10-12
Cutlets, Cubes			6-8		
Lamb	3-6	(3-8)	9	(6-16)	12
Roasts, Chops			10		12
Pork	2	(2-6)	6	(4-12)	12
Roasts, Chops			6		12
Ground Sausage		(1-2)	6	(2-6)	10
Uncured Ham & Bacon		(2)		(4)	
Bacon, green unsmoked			2-4		6
Bacon, Pork or Ham, smoked		(1-3)	5-7	(2-4)	
Lard			9		12
Offal, edible			4		
Beef Liver		(2-3)		(2-4)	
Cooked Foods		(2-3)		(2-4)	

SAFEGUARDING YOUR PRODUCT

SOME POINTS TO REMEMBER

* Prefreezing and postfreezing deterioration is cumulative. Careless handling before freezing can reduce safe storage times.

* Weight loss from frozen meat and associated freezer burn can be prevented by adequate packaging in moisture-impermeable films.

* Slow mould growth may occur on frozen meats, but only at temperatures above -8°C (18°F). 'Black Spot' is the name given to small, dark mould growths occasionally found on frozen meat that has been held for considerable periods of time above -8°C. For practical purposes, microbial growth does not occur below temperatures of -10°C (14°F). Storage temperatures higher than -10°C (14°F) are not recommended.

* Rates of deterioration differ from one product to another. Because of the chemical nature of the fats, pig meats have a shorter storage life than beef and mutton.

* Small cuts and comminuted meats with a large ratio of surface area to weight spoil more rapidly than carcasses and quarters.

* In the range of temperatures available commercially, a temperature reduction of 5°C approximately halves the rate of deterioration.

* Care should be taken to avoid variations in temperature in your store and in your stock. Ensure that all your meat is stacked so that cold air can circulate freely beneath and around the stock. This is essential to avoid warm spots caused by heat leakage through walls and floors. Fluctuating temperatures increase weight loss and reduce shelf life.

* Check your thermometers for accuracy at least once a year. Make sure they are correctly placed to indicate true temperatures within the store.

* Watch your inventory and do not store for longer than necessary. Keep good records. Your customer may want to continue storage elsewhere and to know the time and temperature which have applied in your store.

* The information in the graph is approximate only. It is desirable to check the applicability of the recommendations to your products by checking with your customers or obtaining independent assessments of quality after known periods of storage.

Although -18°C (0°F) is not low enough to prevent all deteriorative changes, it is the highest storage and distribution temperature recommended by many countries in the world. The Australian export industry should base future design on the anticipated need to maintain the meat temperature at -18°C or lower.

ABSTRACTS

Below are some abstracts of recent publications which may be of interest. Copies of publications are restricted to the Australian Meat Processing Industry and can be obtained by completing the attached form. Payment must be made in advance.

1. *SALMONELLAE* IN ABATTOIR EFFLUENTS - M.G. Smith & F.H. Grau. *Australian Veterinary Journal, 50*, September 1974, 410-412, 3p.

Salmonellae have been detected in abattoir effluents in Great Britain (Harvey & Phillips 1961; Jones *et al* 1961; Public Health Laboratory Service Working Party 1964) and Europe (Gibson 1965). Many of the animals slaughtered at some abattoirs in Australia are infected with salmonellas (Grau & Brownlie 1965). This survey was carried out to determine the numbers of *Salmonellae* in the effluents discharged from Australian abattoirs.

Authors' Abstract

2. FACTORS INFLUENCING COOKING LOSSES FROM MEAT - P.E. Bouton, P.V. Harris & W.R. Shorthose. *Journal of Food Science, 41* (1976), 1092-1095, 4p.

Cooking losses from cold-shortened muscle samples with normal (5.4-5.8) pH, cooked at 80°C are significantly ($P<0.001$) greater than those obtained from stretched muscle samples of the same fiber length. Cooking losses increased in samples as length of muscle fibers decreased. The effect of muscle fiber length on cooking losses decreased with longer cooking times. Samples of nearly identical dimensions but different fiber lengths showed significantly greater losses when fibers were less than 4 cm long. The cross-sectional area of muscle samples was shown to have nearly as large an effect on cooking loss as muscle fiber lengths. From measurements of internal temperatures it was shown that sample size determined rate of heating and thus had a major effect on cooking loss.

Authors' Abstract

3. MEAT CHILLING - P.V. Harris. *CSIRO Fd Res. Q.*. 1975, *35*, 49-56, 8p.

It is an unfortunate fact that the tenderness of meat is highly variable. Much of the variability can be attributed to the use of incorrect procedures for chilling the carcass. Important biochemical events occur in muscle after the death of an animal until the muscle has set (or *rigor mortis* is fully developed). During this period, though the animal is dead, the flesh is still a biologically functioning system which becomes progressively more acid. The rate of severity of chilling affects the degree to which biochemical changes occur and is reflected in the two main structural components of muscle, the main contractile mechanism (the myofibrils) and the connective tissue, and also in the ultimate pH of the meat. The toughness of meat is due to the

interaction between the connective tissue and the myofibrillar structures. While it can be said, and with good reason, that it is changes in the myofibrillar component during pre-rigor chilling which affect tenderness, this does not diminish the importance of the connective tissues as a structural component. Muscle with high connective-tissue strength, either as a result of the age of the animal or of anatomical location, will still be tough regardless of myofibrillar contraction state.

In order to discuss the factors which may cause contraction of the myofibrillar structure, and to understand how these factors can be either avoided or reduced, it is necessary to have some knowledge of meat structure and of how tenderness is assessed.

Author's Abstract

4. THE CONTRIBUTION OF HORNED CATTLE TO CARCASE BRUISING - F.D. Shaw, R.I. Baxter & W.R. Ramsay. *The Veterinary Record*, March 27, 1976, 2p.

Five trials were conducted to evaluate the effects of the presence of horns on cattle on carcase bruising. In each trial there were three groups of cattle, hornless, horned and mixed (some with horns and some without). The weight of bruised tissue trimmed from the carcases of the cattle in the horned groups was significantly greater than that trimmed from the carcases of the cattle in the hornless groups. When horned and hornless cattle are mixed the hornless animals in the mixed group sustain significantly more bruising than animals in a group consisting solely of hornless animals while the horned animals in a mixed group have a similar degree of bruising to cattle in a group consisting solely of horned cattle.

Authors' Abstract

5. MANIPULATION OF MEAT QUALITY, PARTICULARLY TENDERNESS, BY THE PROCESSOR - J.J. Macfarlane, P.V. Harris & W.R. Shorthose. *Proc. Aust. Soc. Anim. Prod. 10* (1974), 6p.

Meat tenderness, an attribute highly sought after by the consumer, is directly affected by the treatment of the animal (or its carcass) immediately before, during and after slaughter. This is a consequence of effects on the course of post-mortem glycolysis and on the contraction of muscle. Increase in toughness of muscle as a result of contraction reduces the effectiveness of the traditional aging process for tenderizing meat. The development of enzymes specific in their action on various structural components of meat may further increase the control of meat tenderness by the processor.

Authors' Abstract

6. CONDENSATION IN AUSTRALIAN ABATTOIRS - ITS OCCURRENCE & CONTROL - D.A. Lovett & L.J. Herbert. *Australian Institute of Refrigeration*, April/May 1974, 12p.

Methods of condensation control are reviewed and guidelines suggested for avoidance of condensation at the design stage of new buildings.

Authors' Abstract Abbreviated

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Date 18th April 1977 **Number** 77/2

AN INTRODUCTION TO MICROBIOLOGY

Microbiology is the study of some groups of extremely small living organisms which cannot be seen with the naked eye. These are called micro-organisms, or microbes, and they are of great importance to the meat industry.

WHY ARE MICROBES IMPORTANT?

The surface of a freshly slaughtered carcass is warm and moist, and therefore ideal for the growth of microbes. Contamination of a carcass with microbes can result in:

food poisoning,

spoilage, and

the transmission of disease.

Because of these problems, there is a trend towards the issuing of guidelines or standards of maximum microbial numbers on meat (refer Newsletter 69/6), by individual purchasers and nations. Precautions must therefore be taken to reduce contamination during dressing of the carcasses and subsequent handling and storage of the meat.

Food Poisoning

The term "food poisoning" is used to describe any sickness or illness caused by eating contaminated food. Although food poisoning can be caused by several different microbes, the symptoms are very often similar, viz. nausea, vomiting, abdominal pains, diarrhoea, and headache. *Causes of food poisoning will be discussed in the next Newsletter.*

Spoilage

Meat can be dangerously contaminated without any change in the appearance or smell of the meat. However, the uncontrolled growth of micro-organisms will eventually lead to obvious deterioration which we call *spoilage*. The usual signs are:

* slime
* off-odours
* off-flavours
* discolouration

Although these signs of spoilage do not always indicate the presence of *harmful* microbes, they make the meat unpalatable and its wholesomeness becomes suspect.

Spoilage, due to slime and off-colours, is caused by sheer numbers of microbes. Their effects will start to become apparent when microbes number about 10 million per square centimeter ($10^7/cm^2$) on the meat surface.

A hygienically dressed carcass will have about 1,000 microbial cells per square centimetre ($10^3/cm^2$). During storage and processing the count may rise to about 100,000 ($10^5/cm^2$).

Transmission of Other Diseases

Some animal diseases can be transmitted to humans by contact, e.g. anthrax.

The micro-organisms of concern to the meat industry are primarily the moulds, yeasts, and bacteria:

MOULDS (Fig.1)

The term mould is applied to multi-cellular, filamentous living organisms which are readily recognisable when they grow on food. The 'fuzzy' or cottony appearance of moulds on stale bread or fruit, the whiskers on meat, or the green or black growth on ceilings, all represent countless numbers of filaments (hyphae), or their fruiting bodies.

Moulds normally reproduce by spore formation, but most common moulds can also be grown if any part of the mould is transferred to a fresh medium.

The majority of moulds grow best at room temperature (20-30°C or 68-86°F) but will grow between 0° and 35°C (32-95°F), and are capable of growth on relatively dry surfaces.

Black spot mould (*Cladosporium*) and a few of the white moulds can grow on or below the surface of the meat even when the atmosphere is fairly dry. Because the black spot mould can grow at -8°C (18°F), the storage temperature should be lower than this if meat is to be kept for a long time.

Some moulds can develop slowly at temperatures below freezing, but profuse growths of green mould and of 'whiskers' on meat stored in a freezer usually indicate that the temperature rose to freezing point or slightly higher at some time during storage.

To prevent mould growth on frozen meat, temperature fluctuations should be prevented and the temperature should be kept below -8°C (18°F).

YEASTS (Fig.2)

Yeasts are single-celled living organisms, usually at least four times the diameter of bacterial cells. Most yeast cells are oval or ellipsoidal in shape.

The presence of yeasts is necessary during the manufacture of bread and beer, for example, but yeasts can also cause spoilage of meat (e.g. brown spot on vacuum packed meat), and other foodstuffs.

Yeasts are widely distributed. They are present in nature wherever a good source of carbohydrate (sugar or starch) is available.

FIG. 1: Typical moulds showing fruiting bodies (magnified 40 times)

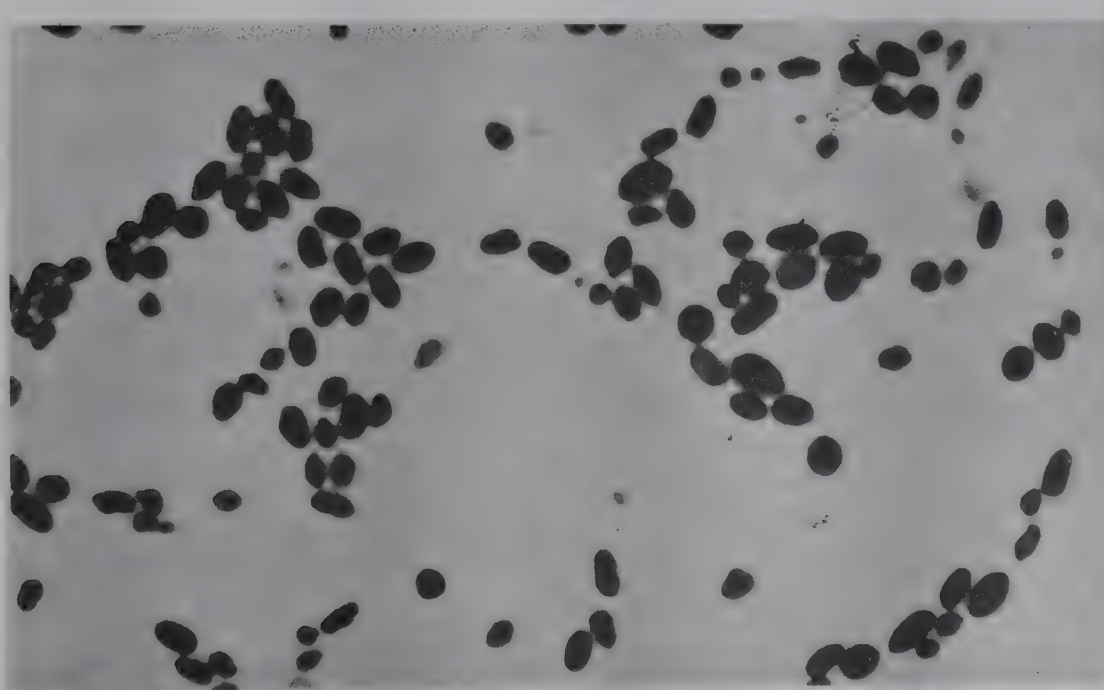

FIG. 2: Budding yeast cells (magnified 1200 times)

The most common means of yeast reproduction is by *budding*. After a cell reaches a certain size and age, a small bulge or bud forms on the side of the cell. When the bud becomes sufficiently large, a cell wall is formed between the bud and the mother cell, and the bud separates as a new cell.

Most yeasts, like the moulds, grow best at room temperature, but some yeasts can grow at 0°C (32°F). Generally, yeast growth is inhibited at temperatures above 37°C (100°F), and yeasts require more moisture than moulds, but less than bacteria.

If meat is exposed for some time to temperatures a few degrees above freezing point, small white or pink yeast colonies may develop. Under moist conditions the colonies show up as tiny semi-translucent spots. When these colonies dry they can turn brown.

Yeasts and moulds are easily killed by heat during cleaning, and are seldom a problem in the meat industry.

BACTERIA (Fig.3)

Bacteria are very small, single-celled living organisms. They are smaller than yeast cells and vary in size from 0.2-5 microns, with an average size of 1.5 microns (1 micron = $\frac{1}{25,000}$ inch).

Bacteria can be seen only with the aid of a microscope, usually at a magnification of one thousand times. A cockroach magnified to this extent would be a monster 30 metres long.

Bacterial cells are of many shapes. The three basic forms are: 1) round or spherical (*coccus*), 2) cylindrical or rod-shaped (*bacillus*), and 3) spiral (*spirillum*) (Fig.4).

The *cocci* include such organisms as those that cause "strep throat" and *staphylococcal* food poisoning. The *bacilli* or rod-shaped bacteria include organisms responsible for fresh meat spoilage and sausage greening, and diseases such as tuberculosis, anthrax, salmonellosis, and botulism. Many *bacilli* are present in human intestinal tracts. The *spirilla* group contains bacteria causing leptospirosis and syphilis, but some are harmless soil or water bacteria.

Bacteria are widely distributed throughout nature. Because of their small size they can be transferred from location to location by air currents (or dust particles), insects, birds and mammals.

FIG.3: Bacterial rod-shaped cells (magnified 1200 times)

FIG.4: Basic shapes of bacteria

Some bacteria are motile, moving by means of flagella, while others are non-motile. The flagella are extremely thin, hairlike appendages that protrude through the cell wall.

To help identification, bacteria are divided into two groups, the Gram positive and Gram negative bacteria. The Gram positive bacteria retain certain dyes while this dye can be removed from Gram negative bacteria with alcohol.

Some bacteria have the capacity to produce small, highly resistant cells which are termed *spores* or *endospores*, because they are formed within the cell. Compared to vegetative cells, spores are extremely resistant to physical and chemical agents such as heat, cold and sanitizers. Canned foods must be subjected to a high temperature under pressure in order to destroy any dangerous spores that could be present. The spores of greatest concern in canned foods are those of the botulism organism which, when growing in the vegetative state, produce a lethal toxin (poison).

Reproduction of Bacteria

Bacterial reproduction (growth) takes place by binary fission. One cell grows and divides into two equal parts or cells, which in turn divide to give a total of four cells, and so on.

The time taken between divisions is the generation time or doubling time. If we consider 20 minutes as the generation time, which is possible for many bacteria grown under ideal conditions, a single bacterium would produce more than two million progeny in seven hours.

The growth of bacteria is normally limited by the exhaustion of available nutrients and/or by the accumulation of toxic bacterial end-products. Because these changes in the environment are produced by the bacteria themselves, the development of bacterial populations is typically self-limiting, and after growth has ceased the population starts to decline.

Factors Affecting Growth of Bacteria

The rate at which growth or division occurs varies with different bacteria and is mainly affected by the temperature, moisture, pH, atmospheric composition and nutrition.

Temperature:

Temperature has a major effect on the bacterial growth rate. Bacteria may grow over a wide temperature range and are classified roughly according to the temperature at which they grow.

The majority of the bacteria grow best at the warmer temperature of 30-40°C (86-104°F), with a range of 7-43°C (45-110°F), and are termed mesophiles. Bacteria which can grow at lower temperatures are called psychrophiles. The psychrophiles grow in cold environments (refrigerator temperatures) but usually grow faster at 16-32°C (60-90°F). Bacteria that grow well at a high temperature (50-65°C [122-150°F]) are called thermophiles.

In the meat industry the psychrophiles, or bacteria that grow at low temperatures, are responsible for the spoilage of fresh meat, though the mesophiles, a group that includes the disease-producing bacteria (pathogens), are of prime importance if one is considering the wholesomeness of the meat.

To minimise the growth of bacteria, conditions which will reduce the growth rate have to be created. The temperature of *optimum* bacterial growth is 20-40°C (68-104°F) for most bacteria. Obviously, the nearer the storage temperature of meat approaches the optimum for bacterial growth, the more rapidly the meat will spoil.

The final temperature range to which the meat is chilled is important not only because it affects the length of storage life but also because it will determine which types of bacteria will spoil the meat.

If the meat is chilled to a temperature below 7°C (45°F) mesophilic organisms, including most pathogens, will not grow but psychrophilic organisms will grow slowly and will become the spoilage organisms. Fig.5 shows the effect of temperature on the growth of spoilage and food poisoning bacteria on moist meat. It can be seen that small changes in temperature have a considerable influence on the growth rate. For example, *Pseudomonas* grows very slowly at 0°C (32°F), but if the temperature is raised by only 5° the growth rate is much faster and contaminated meat will spoil twice as quickly. Temperature control is therefore of prime importance.

In frozen meat, bacterial growth usually ceases or is so slow that it is of no importance. Once the meat is thawed, however, the bacteria can resume growth and the meat will spoil.

Although chilling temperatures are important, other factors play important roles in reducing growth rates of bacteria on the surface of the meat:

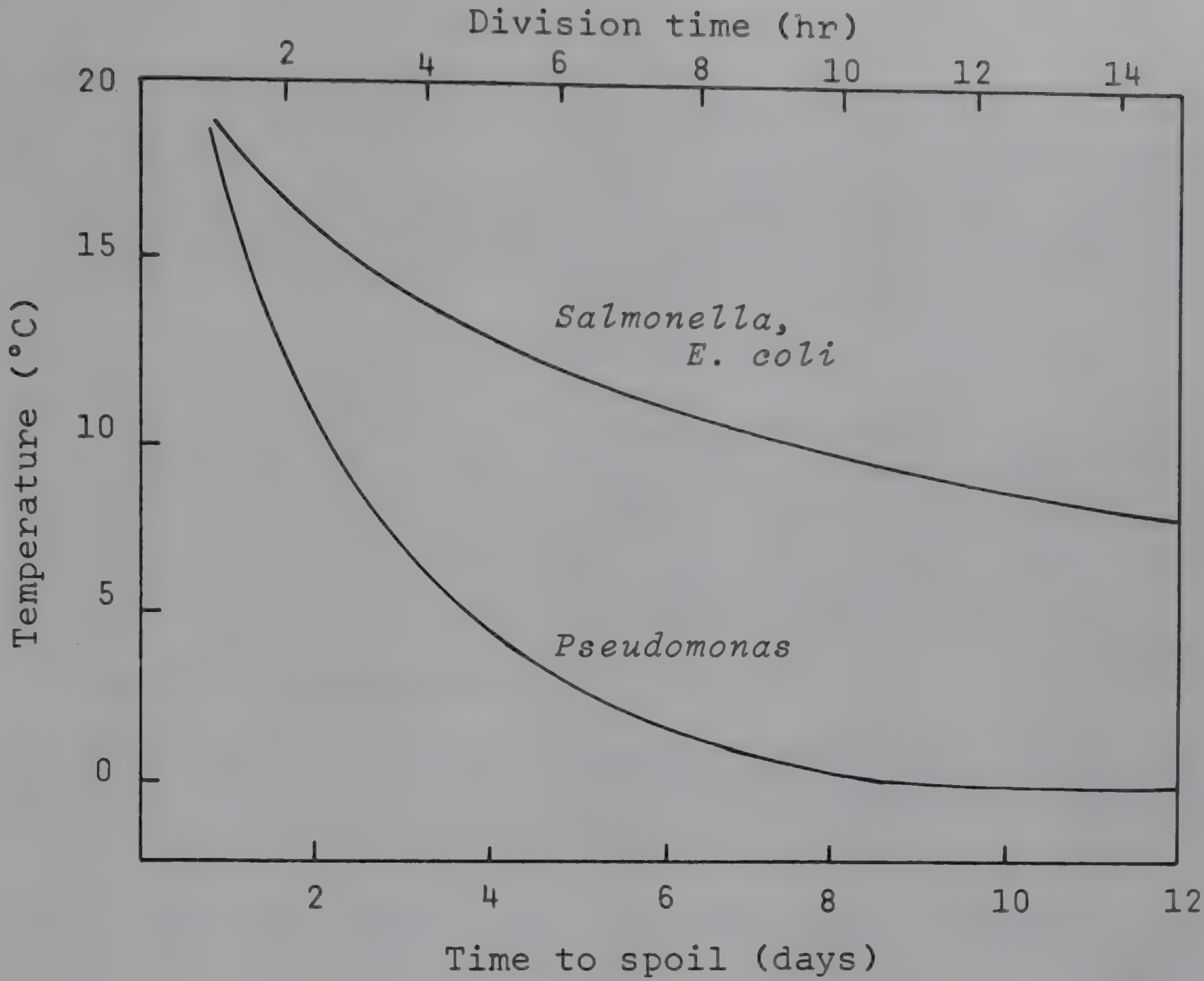

FIG.5: Effect of temperature on the growth of food poisoning, and spoilage bacteria on moist meat (experimentally held at 99.3% RH)

Moisture:

Like any living organism, bacteria need water before they can grow. Drying is the oldest method of preserving meat.

Generally, bacteria need more water than yeasts and moulds. The water has to be available, and not bound by salt, sugar or ice.

When the hot and moist carcass enters the chiller, water will evaporate from the surface of the carcass due to the difference in partial vapour pressures between the chiller environment and the surface of the meat. The greater the difference in temperature the more rapid the loss of moisture. Air movement is important at this stage to maintain the

difference in partial pressures. After the carcass has cooled a further loss of moisture will occur, the extent being determined primarily by the relative humidity. If chillers are overloaded, so that carcasses are touching, or the chillers are operating at high humidities and temperatures, drying of the surface of the meat will be prevented and the storage life will be shortened.

pH - Measure of Acidity and Alkalinity:

Most bacteria grow over the range pH 4-8, but the optimum growth is usually near pH 7. Below pH 6, growth slows, and because normal post-rigor muscle is often in the range 5.5-5.8, the bacteria will grow much slower than the bacteria on 'dark cutting' meat with a pH 6.0-6.8. For this reason, when we select meat for ageing, 'dark cutting' meat is not used.

Atmospheric Composition:

Some bacteria (*aerobes*), such as *Pseudomonas*, can grow only in the presence of oxygen, while others (*anaerobes*), such as *Clostridium*, grow only in its absence.

Other organisms (*facultative anaerobes*), such as *Lactobacillus*, are indifferent and grow just as well without oxygen as with it; while *Salmonella* and *E. coli* grow faster in the presence of oxygen, but can grow without oxygen.

Vacuum packaging of meat will prevent spoilage by *Pseudomonas*. However, the *facultative anaerobes, Lactobacillus* and *Microbacterium*, are not prevented from growing. These bacteria, unlike *Pseudomonas*, are also resistant to the presence of carbon dioxide, which accumulates in the head space, and *Lactobacillus* will be the predominant organism in the final product.

There is little doubt that there will be a continuing trend towards microbiological specifications for meat products. A better knowledge of microbes by existing production staff will help to meet these needs. In the long term, meat companies will probably need to employ qualified microbiologists as consultants or staff members.

Below are some abstracts of recent publications which may be of interest. Copies of publications are restricted to the Australian Me Processing Industry and can be obtained by completing the attached fo Payment must be made in advance.

EFFECTS OF DIFFERENT SLAUGHTER METHODS ON BLEEDING SHEEP - D.K. Blackmore & J.C. Newhook. *The Veterinary Record*, October 16, 1976.

One hundred and sixteen sheep were slaughtered by five different methods in an attempt to determine the most practical technique which would result in rapid exsanguination without incision of the oesophag Techniques which involve stunning prior to slaughter were compared wi the traditional New Zealand method by which fully conscious sheep are slaughtered by almost simultaneous severance of the major blood vesse of the neck and the spinal cord at the occipito-atlantal junction. Total amounts of blood lost and rates of bleeding were compared.

Authors' Abstra

NEW FATS & OILS FROM LOW-COST SOURCE - *Food Engineering Int'l*, July 1976. 3p

Beef tallow - widely available at a low price - may be headed for important new markets in the future. USDA researchers in Philadelphia have developed a laboratory multi-step fractionation process that converts the tallow into: (1) a replacement for cocoa butter; (2) a liquid oil competitive with palm oil; (3) a non-hydrogenated shortening; and (4) combinations of the above in the form of specialt fats and oils.

The most important development appears to be the use of fractionated tallow as a replacement for cocoa butter; the composition of the two products is very similar. However, the fractionation process for tallow also yields a liquid oil, which is valuable as a food oil for salad or cooking use, and the third product obtained from the tallow fractionation process is a crystalline solid that can be used to harde shortenings and margarine stock without incurring the expense of hydrogenation.

From the multitude of glycerides of beef tallow of the saturated-unsaturated acid combinations, specific glycerides were segregated according to their behaviour pattern in solvents such as acetone at various temperatures. These fractions have a physical nature far different from that of the original tallow, but they are still complex mixtures of glycerides.

CURRENT REFRIGERATION PRACTICES IN AUSTRALIAN ABATTOIRS - K. Visser. *International Institute of Refrigeration, Australian National Committee*, Paper No. 20 (6-10 September 1976). 8p

Australia is the world's leading meat exporting country. As a consequence, industrial refrigeration plants in Australian abattoirs ar packing plants are generally designed to maintain conditions and achiev chilling rates required by the meat importing countries. The Australia Department of Agriculture enforces these requirements. In addition, th United States Department of Agriculture has its own representatives stationed permanently in this country. The designers of industrial refrigeration systems for abattoirs, which are the major users of large plants, have to find solutions to the following basic requirements:

1) Product weight losses during the post slaughter chilling cycle shou be a minimum.

2) The final product temperature must not exceed 7°C after a certain period of time.

3) At any time during the chilling and subsequent deboning cycles the space temperature must not exceed 7°C.

4) Condensation in chillers, passages and process areas should be eliminated.

5) Where meat is to be deboned a uniform carcass temperature as high a permissible is desirable to retain good cutting properties of the meat, which deteriorate when the fat on carcasses sets hard when to cold, not infrequently resulting in reducing productivity.

6) Tender meat, especially for local consumption.

7) Draughty conditions in process areas should be eliminated, due to resulting bad working conditions and possible industrial action by employees.

8) Energy consumption and other owning and operating costs should be a minimum consistent with the desired results.

The above requirements are conflicting and a happy compromise between them has to be arrived at if possible. In the following sectio it is endeavoured to explain how the problems are attacked in this country.

Author's Abstra

THE INFLUENCE OF FREEZING PRACTICE ON THE QUALITY OF MEAT & FISH - C.L. Cutting. *Australian Refrigeration, Air Conditioning and Heating*, February 1977.

Freezing is the pre-eminent method of long term preservation for coping with seasonal and geographical variations; it is also invaluabl in reducing the perishability of meat and fish during commercial distribution.

Freezing and cold storage induce physical and chemical changes in meat and fish which preclude perfect restitution of the status quo ante Nevertheless, detrimental differences need be only of minor importance i present knowledge is properly applied in practice, and the slight losse in quality are heavily outweighed by the greatly increased storage stability in frozen state.

Freezing is not generally in competition with canning and it is not likely to be seriously challenged by either freeze-drying or irradiatio Continued expansion of the frozen meat and fish industries seems assure

Author's Abstra

THE EFFECT OF ENVIRONMENTAL CONDITIONS ON THE CHILLING TIME & MOISTURE LOSSES OF BEEF CARCASSES - G. Kerens. *Int. Inst. Ref., Aust. Nat. Comm.* Paper No.40 (6-10 September 1976). 8p

The Council for Scientific and Industrial Research has been directl concerned with testing newly installed refrigeration installations at abattoirs. Although the primary object of these tests was to ascertain whether the specified requirements for the plants could be met, use was

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Date 16th August 1977 **Number** 77/4

CATTLE HANDLING SYSTEMS FOR MEATWORKS

In order to design efficient corral (i.e. yard, pen and race) systems for handling cattle at a meatworks you need to understand how the animal perceives the environment around it. Cattle have wide panoramic black and white vision. They can see a full 360 degrees because their eyes are located on the side of the head (Figure 1). However, depth perception is poor, and dark shadows may appear to be solid objects. Because of this, cattle are liable to take fright if they come across dark shadows or bright areas in the confines of a race or crowding pen. Consequently, the best type of lighting in a cattle handling area is even and diffuse.

Due to their wide panoramic vision, objects which move suddenly, such as a piece of paper blowing in the wind, are also likely to frighten cattle. Flapping objects (e.g. a coat hung over a fence) should not be permitted within the animals' view. Ideally the animal should be able to see only the place where he is supposed to go. If he becomes distracted he is likely to balk. Races should be designed with high solid sides to prevent the cattle from seeing out.

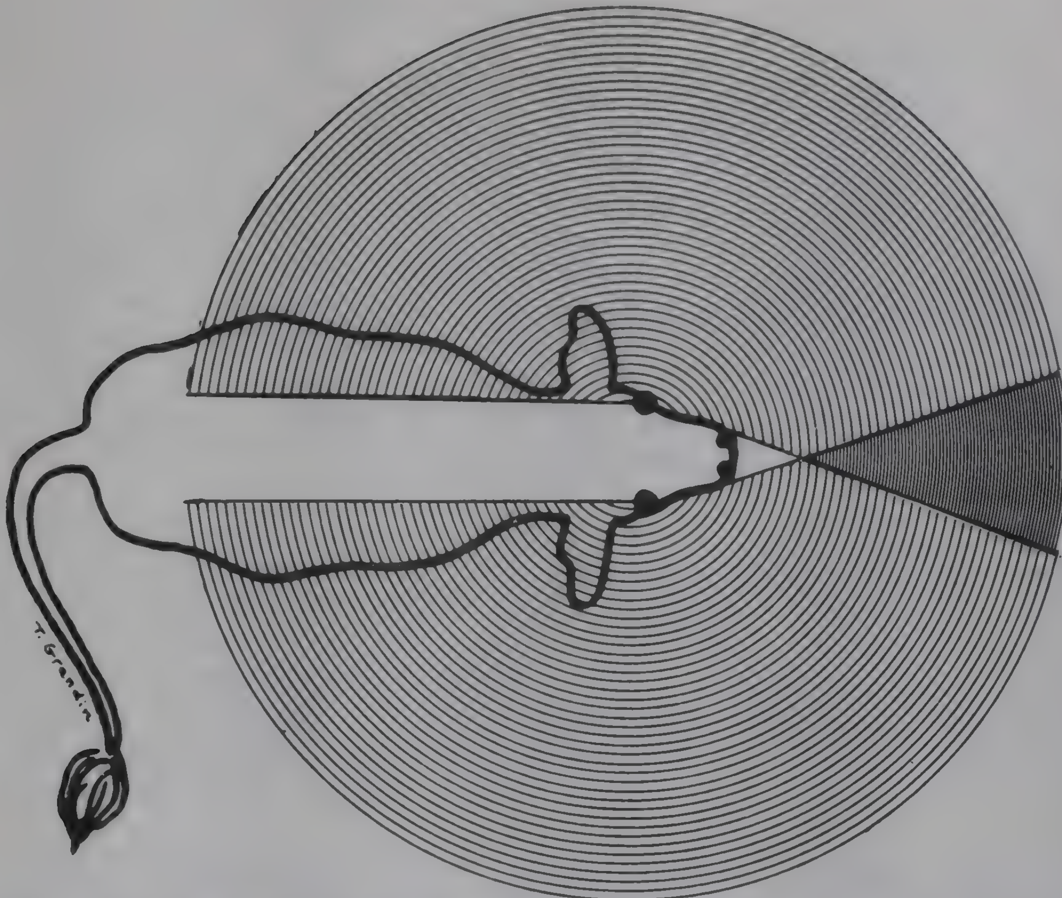

Figure 1: Cattle have panoramic vision, as shown in this drawing. The area covered by the coarse concentric circles represents the animal's field of vision in which it has no depth perception. The small shaded area in front of the animal's head represents its binocular field. It has depth perception in this 25 to 50 degree area.

Cattle will follow a curved path more readily than a straight one. This may be partially explained because the animal's visual field is distorted. The visual field is curved and globular like the view seen through a fisheye lens. Another factor is that the animals will follow the leader around a curve. They see an opening to escape to, but they cannot see what is ahead until they are practically there.

Cattle are herd animals and they will follow the leader. A group of cattle will flow easily through a well designed facility. The most efficient corral systems are constructed with curves and diagonals. Ninety degree corners should be eliminated. The designer of a corral system should imagine that a group of cattle will flow through the system like a heavy liquid. The concept of flow is important. There should be no sharp corners to produce "turbulence."

In the United States many large cattle operations utilize long narrow pens with a gate on each end for sorting, holding and handling cattle. The pens are set on a 60 degree angle and they are 22 metres long (Figures 2,3). All of the traffic is one way. After the cattle are unloaded they enter the pens through one end and leave to go to slaughter through the other end. The large pens hold truck load lots and the small pens hold lots of just a few animals. The small pens have block gates to keep lots of one or two animals separated. The recommended width dimensions for the diagonal pens are 3.5m for the large pens and 3m for the small ones. To expand the capacity of the layout, more pens should be added. Pens should not be lengthened beyond 22m, since bunching and other problems will result.

Races for driving groups of livestock should be 3m to 3.5m wide. To eliminate sharp corners the gates on the diagonal pens should be longer than the drive race is wide. The length of the gate is related to the width of the pen. On a 3m wide race, 3.5m to 4.1m gates are recommended. On a 3.5m race the recommended gate length is 4.1m. Block gates located along the unloading race for the control of cattle and for keeping the lots separate should be the same width as the race.

When the animals leave the diagonal pens to go to slaughter, they pass through the main drive race to the curved holding race (Figure 4). The fences of the curved holding race are high and solid to prevent the cattle from seeing out. Solid sides are important to avoid fright resulting from outside distractions such as people and blowing paper. The curved holding race has block gates to keep the lots separated. Cattle will follow the leader along the curved holding race to the circular crowding pen.

The circular crowding pen (Figure 5) is used to force the animals into the single file race. The crowding pen is equipped with a 3.5m long gate which is used to crowd the animals as they enter the single file race. The crowding pen gate should be solid. This will prevent the cattle from turning and looking out through the gate instead of entering the race.

The single file race (Figure 6) which leads to the stunning pen is V shaped. This makes it possible to handle a variety of cattle sizes, and helps to prevent the animals from turning around. The race should have high solid sides and be curved. The recommended inside radius for the single file race is 5m. The inside dimensions of the single file V race are 50cm at the bottom and 80cm at the top. The 80cm measurement is taken at the 150cm level.

At some meatworks bars are placed over the top of the V race to keep the cattle from jumping up and falling over backwards (Figure 7). There are advantages and disadvantages to these bars. If it is decided to use them, they should be placed 150cm from the floor of the race. If you prefer a race which is open on the top, the sides should be 180cm or higher.

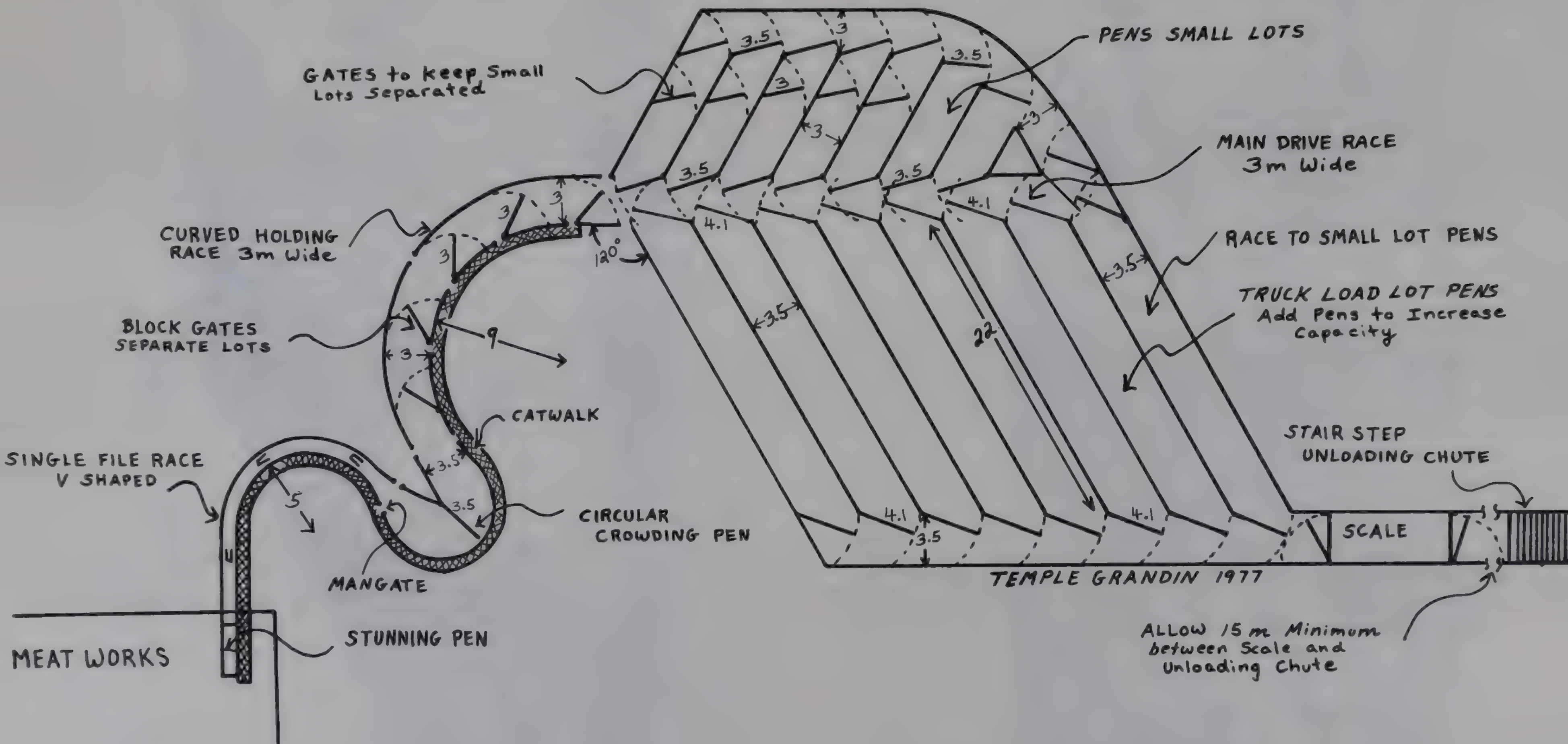

Figure 2: Illustrates a meatworks corral system with all the holding pens and races set on a 60 degree angle. The traffic is all one way and cattle will move through curves and diagonals more easily than through square pens. All measurements are in metres.

Figure 3: In this diagonal pen layout the cattle enter through one end and leave through the other. Note that the gate is longer than the width of the drive race. This eliminates the sharp corners. The pens are on a 60 degree angle.

Figure 4: A curved holding race greatly increases the efficiency of moving cattle to the crowding pen and the single file race. Note that the fence is high and solid to prevent the cattle from seeing out. Block gates are provided to keep the lots separated. This race should be 3m to 3.5m wide. The recommended inside radius is between 9m and

Figure 5: *The man is pushing the crowding gate to force cattle from the circular crowding pen into the V shaped race. For most efficient handling the catwalk platform is 100cm from the top of the fence. To avoid excessive prodding, overhead catwalks should be avoided if possible.*

Figure 6: *This is a well designed curved single file V race with high solid sides. The solid sides prevent the cattle from looking through or over the fence and prevent handling problems due to fear of people and other*

To prevent the cattle backing up in the race, one way antiback up gates should be placed 5.2m to 6m apart. The cattle can pass through the one way gate but they cannot back up. These gates should work easily and not clang. Noisy one ways will cause animals to balk.

The ideal length for the single file V race is determined by the hourly rate of the meatworks. In order to maintain a steady, uninterrupted flow of cattle to the kill line, the V race must be long enough to maintain flow. Assume that approximately two 400 kg cattle will fit in a 3m section of V race. Three 250 kg cattle will fit in each 3m section. In a meatworks where 25 to 60 head per hour are processed the recommended length for the V race is 18m. In works with two hide pullers, 120 head per hour can be processed, and here are recommended 36 lineal metres of V race.

In the larger works it is advisable to have two V races located side by side (Figure 8). If an animal goes down in one of the races, the other race can be used to keep the kill line supplied with cattle. Divider gates are used to switch the cattle back and forth between the two races (Figure 9). Since these gates take up some of the space in the race, it is recommended that an extra three metres be allowed. At a 120 head per hour works, two 21m races would be needed.

For ease of cattle handling, catwalks should be provided alongside the V race, crowding pen and curved holding race. For best results and maximum worker safety the surface of the catwalk platform should be 100cm from the top of the fence. This brings the top of the fence waist high on the average man. Overhead catwalks should be avoided. They tend to encourage excessive prodding and agitation of the cattle. In areas with solid fences, mangates should be provided so that people can escape from wild cattle.

One of the principles of designing facilities for cattle handling is that you want the cattle to see a way of escape, but you do not want them to see too much and become distracted or frightened. It is like putting blinkers on a horse. The cattle can always see an opening as they walk down a curved race but they cannot see the stunning pen until they are almost in it. In a long straight single file race, cattle will balk and bunch up at one end because they are afraid of all the commotion and noise at the other end.

Cattle will often balk and refuse to move if they are persuaded to approach something which appears to be a dead end. Sliding gates, one way gates and other doors in the single file race should be made of expanded metal or closely spaced steel bars. This will enable the cattle to see through them. If a solid gate is closed across the entrance to the single file race, the cattle will often refuse to approach it, because they cannot see an opening.

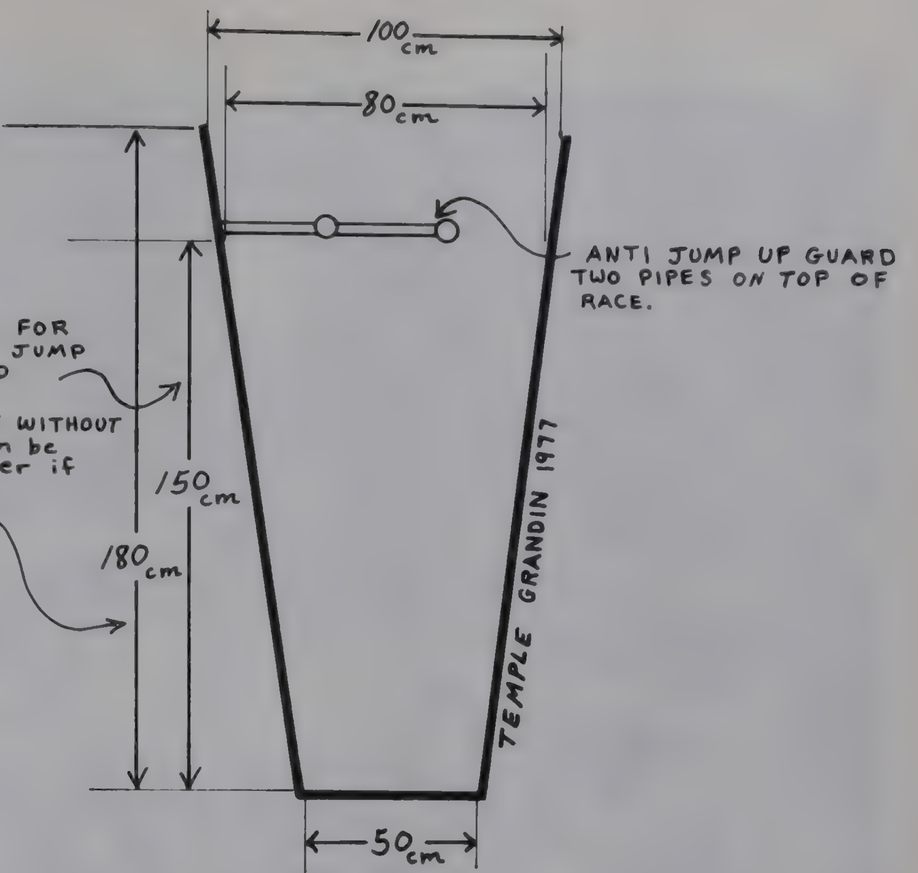

Figure 7: In meatworks where a variety of cattle sizes are processed a V shaped single file race is recommended. This diagram shows the recommended dimensions for use with or without an antijump up guard.

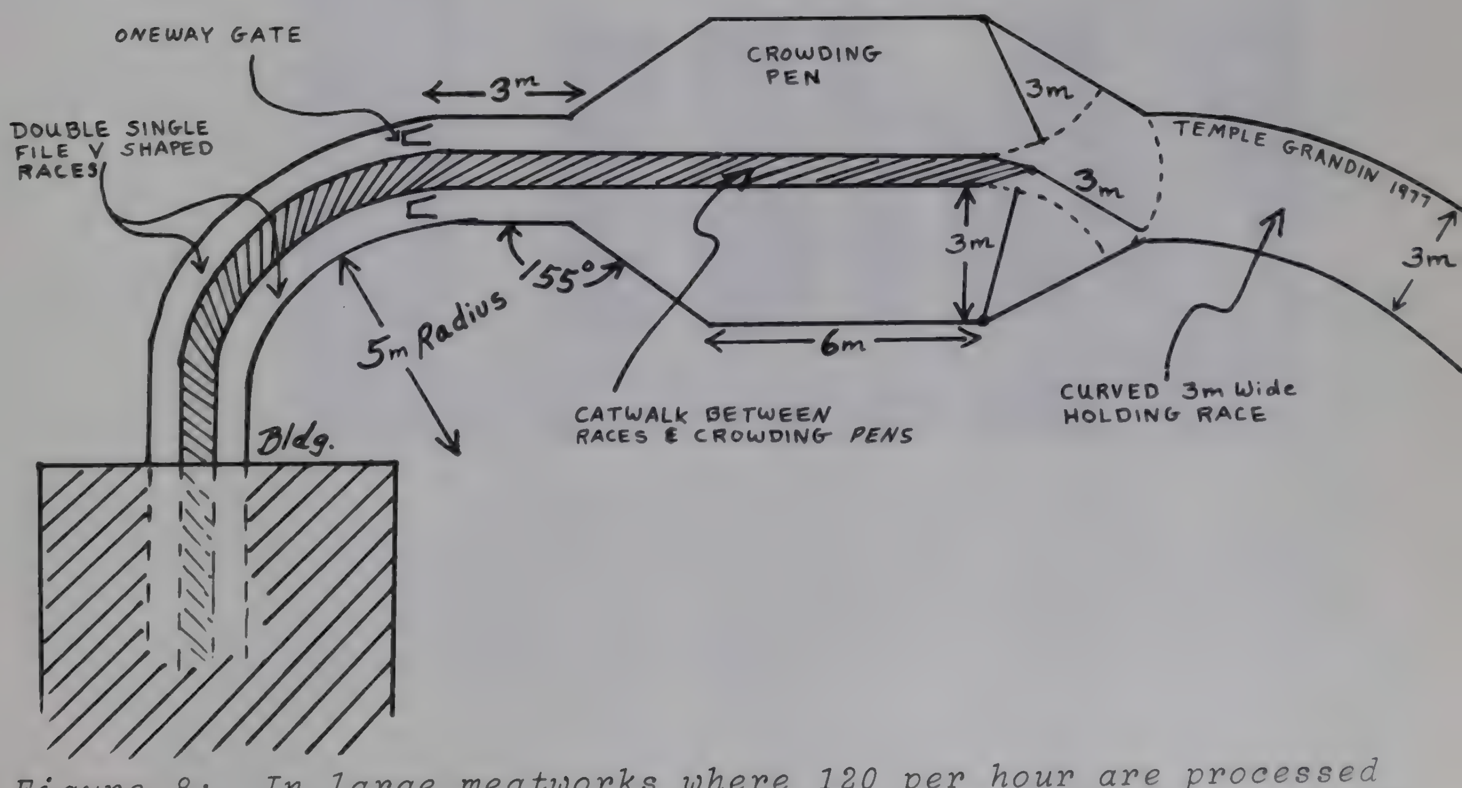

Figure 8: In large meatworks where 120 per hour are processed it is recommended to have two single file races. If an animal gets down in one side the other side can still be used. The catwalk is between the two races

Figure 9: Double single file races are used in large meatworks. Note the air operated divider gate to switch back and forth between the two races. The catwalk down the middle provides the handler with easy access to the cattle.

Unlike the loading ramps which are used on cattle properties, the unloading ramp at the meatworks is used for UNLOADING ONLY. Since it is used to UNLOAD ONLY, it should be wide and straight. This enables the cattle to see a clear path of escape. If the ramp is used for both loading and unloading it should be curved and be just wide enough so that the cattle can line up single file. Curves are needed when you are persuading the cattle to enter something, like a truck or a meatworks. The recommended dimensions for stairsteps in loading and unloading ramps is a 9cm to 10cm rise and a 30cm run. The incline of the ramp should not exceed 20 degrees.

Single file races in feedlots and meatworks should never slope downward. Walking downhill is hard on cattle. The cattle will often balk if they are forced to line up single file and wait in a single file race which slopes downhill. In meatworks the upward slope of the single file ramp should not exceed 20 degrees, and it should have the same stairsteps as those described for the unloading chute.

Cattle are sensitive to high pitched noises and shouting should be kept to a minimum. Steps should be taken to minimise the banging and clanging of gates and the noise of other equipment.

The secret of good cattle handling is to prevent the cattle from getting excited. Once an animal has balked or refused to enter a race or pen, it is likely to balk again and again. It is important to handle cattle properly the first time.

ACKNOWLEDGMENT

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ABSTRACTS

Below are some abstracts of recent publications which may be interest. Copies of publications are restricted to the Australian meat processing industry and can be obtained by completing the attached form. Payment must be made in advance.

"THE EFFECT OF MARINADING ON BEEF," by Lynette M. Wenham & Ronald Locker, *J. Sci. Fd Agric.* 1976, *27*, 1079-1084. 6p

Beef *sternomandibularis* muscle was tenderised by marinading i 1.5% acetic acid. The effect was marked whatever the cooking temperature, but greatest with mild or severe cooking (60 or 100°C Addition of 12% sucrose further increased tenderness. Juiciness w not improved, with or without sucrose. *Longissimus dorsi* steaks when marinaded and grilled showed only a small increase in tenderness. Lengthy soaking of a thick steak is necessary to achieve full penetration of the marinade. Marinading appears to b particularly effective in tenderising muscles containing a large amount of connective tissue, but the benefit is marginal in top quality cuts.

Authors' Abstra

"THE UTILIZATION OF BLOOD AND OTHER SLAUGHTER BY-PRODUCTS," by V.M Gorbatov, *Europ. Meat Res. Workers Cong. 22(11)*:10, 1976. 5p

Gorbatov of Russia reviewed the utilization of the various by products from slaughtering of livestock as human food. The author emphasized that over one third of the animal is considered to be b products, which include the blood, bones, offal and other by-products that are often poorly utilized by the industry. He indicated that certain of these products, namely the blood, liver, tongue, spleen, heart and kidneys, are similar in amino acid composition to the meat *per se*. Also a considerable amount of protein, although poorer in quality, is contained by the lungs, tripe, abomasum, ears, lips, weasand, intestines, rind (hide) and bones. Proper handling and utilization of these by-products can materially increase the amount of animal protein recovered for hum food.

Of special interest is the fact that some 40% of all the bloo from slaughtering in Russia is being recovered and used as human food. The process being utilized makes use of the hollow knife to allow collection without contamination and results in reclaiming about 3.5% of the animal's live weight. Each metric ton of blood yields about 1,380 lb of plasma and 792 lb of red cells. The plas can be added to meat products up to a level of 10-20% without greatly affecting the quality. Although space does not permit further discussion of this extremely interesting paper, reclamatio of the other by-products is also discussed in some detail.

Author's Abstra

"PROCESSING DAMAGE TO LYSINE AND OTHER AMINO ACIDS IN THE MANUFACTURE OF BLOOD MEAL," by Paul E. Waibel, Margita Cuperlovic, Richard F. Hurrell & Kenneth J. Carpenter. *J. Agric. Food Chem.*, *25*, No.1, 1977. 5p

Four vat-dried and five ring-dried blood meals were analyzed

on the average, 9% less total lysine and 26% less fluorodinitrobenzene (FDNB)-reactive lysine than did the ring-dried blood meals. Using rats, chicks, and turkey poults for growth assays the potency of vat-dried blood meals as sources of lysine ranged from 0 to 43%, and that of ring-dried samples ranged from 80 to 97%, of the corresponding total lysine values. The vat drying resulted in an equally severe reduction in bioavailability of methionine, and the digestibility of the protein as a whole was greatly reduced. The ring drying procedure, involving short time, high temperature heating, resulted in a product of reasonably good quality. Blood was not particularly sensitive to heat damage in controlled heating tests. Mixing blood with either corn meal, wheat bran, or starch prior to drying resulted in greater damage.

Authors' Abstract

"FREEZING TRENDS AND TECHNIQUES," by F.J. Nicholson, *Australian Refrigeration, Air Conditioning and Heating*, May 1977. 4p

Reference is made to trends in frozen food consumption and increased use of freezing plant. Existing types of freezers and their advantages are considered and possible trends in future developments of freezing equipment for the fishing industry are discussed.

Editor's Abstract

"MODERN DESIGN AND CONSTRUCTION OF LARGE COLD STORES IN NEW ZEALAND," by A.J. Barnard, *International Institute of Refrigeration, Australian National Committee*, Paper No.18 (6-10 September 1976). 7p

In his paper to the Cold Storage & Ice Association in London in 1904, Cameron reported that in the previous year frozen shipments of sheep and lamb from New Zealand amounted to 4.9 million carcasses, or about 120,000 tonnes. Whilst the volume of storage provided to hold this quantity of meat is not reported, one can calculate that the volume required for storage of the total annual kill would be about 400,000 m^3 and can assume that the actual volume available would have been significantly less.

Fleming reports the latest estimate of total cold storage availability in New Zealand as 2.1 million m^3, of which about 1.3 million m^3 is owned by the meat export industry with an annual meat export of 800,000 tonnes. One can see, therefore, a considerable growth in cold storage volume in 70 years, from a base which was initially high in relation to population - 840,000 Europeans in 1904, and 3.2 million population today.

Today the largest units, up to 30,000 m^3 capacity, are to be found in the meat export industry, and these are discussed.

Author's Abstract

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55

Meat Research News Letter

CSIRO Division of Food Research
Meat Research Laboratory

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Date 3rd October 1977 **Number** 77/5

PHARMACEUTICALS & OTHER FINE CHEMICALS

FROM ANIMALS

A considerable number of fine chemicals are produced commercially from animal tissues. Those fine chemicals obtained in commercial quantities have been grouped according to type in the following list. Products marked with an asterisk are currently produced in Australia:

PROTEINS:

Bovine serum albumin*
Purified foetal calf serum*
Gelatine*

STEROIDS:

Cholesterol
Cholic acid
Deoxycholic acid

HORMONES:

Insulin*
Glucagon
Pituitary gland powdered extract*
Adrenocorticotropin (ACTH)
Thyroid and Parathyroid

ENZYMES:

Pancreatin
Trypsin
Chymotrypsin
Ribonuclease
Deoxyribonuclease
Rennet*
Pepsin

ANTICOAGULANTS:

Heparin**

Pharmaceutical companies are primarily interested in compounds obtained from the glands of livestock, but some compounds are found in other tissues.

Few Australian companies are involved in the actual manufacture of pharmaceuticals from animal byproducts, most being associated with the formulation, packaging and marketing of imported compounds. The Commonwealth Serum Laboratories, however, do manufacture pharmaceutical products such as insulin from raw materials obtained in Australia.

Various collection agencies operate in Australia to obtain raw materials for overseas interests. Some of this material is eventually sold back to Australia as a finished product, presumably at a much higher price than if the product were locally manufactured. The growth of an Australian drug manufacturing industry in this area would require the co-operation of the meat industry for the supply of raw materials, and in turn would benefit the meat industry by providing an outlet for byproducts which often go to waste.

**Sometimes prepared in Australia.

The total amount of a given pharmacologically active material obtained from one animal is very small. A large number of animals are therefore needed to ensure adequate supply. For example, the insulin required by one diabetic for one year is derived from the pancreas glands of about 26 cattle.

PROTEINS

Albumin (from blood) and gelatine (from collagen) are two proteins that can be obtained in fairly large quantities. Blood proteins make up about 10% of the total protein content of an animal and collagen about 33%.

SERUM ALBUMIN

Beef blood contains about 63% liquid plasma, of which approximately 3½% is albumin, and 4% is globulin plus fibrinogen. Crude blood albumin is used mainly as a meat substitute in prepared meats, and in a protein-deficient world this use is likely to grow.

Pure serum albumin is produced from ox blood as either crystalline serum albumin or fraction V bovine serum albumin. These products are used widely in research and clinical medicine. Bovine serum albumin (BSA), which is highly purified and despecified, is used for the counteraction of blood or fluid loss in domestic animals. BSA is also used as a component of moisturizing creams and lotions.

Amino acid mixtures made from blood are used for intravenous feedings.

Purified foetal calf serum is used as a nutrient for tissue culture in medical research.

GELATINE

Gelatine is a heterogeneous protein preparation obtained by selective hydrolysis of collagen. The major use of gelatine is in food, but its special physical properties make it useful in pharmaceutical and photographic industries.

In Australia, food grade gelatine is manufactured from the connective tissue of animal skin, hocks or trotters, and tendons.

The conversion of collagen into gelatine results from hot water extraction of the collagen-rich tissues after they have been subjected to simple physical and chemical treatments. The properties of the gelatine so obtained are greatly influenced by the nature and quality of raw materials used, and by the extent of hydrolysis of the collagen.

STEROIDS

The steroids which are extracted commercially from animal tissue, are cholesterol and the two bile acids, cholic acid and deoxycholic acid. There are many steroids present in the adrenal cortex, but quantities are too small to compete economically with the corticosteroids (e.g. cortisone) manufactured from plant sources. In Australia there is no steroid manufacturing industry.

The world demand for steroid drugs, particularly the oral contraceptives, the corticosteroids and other steroid hormones, is rapidly increasing. Of the steroid hormones the most important, from the viewpoints of demand and social pressure for their use, are the sex hormones, particularly those that regulate the female reproductive cycle. The oral contraceptives in use today normally contain two steroid sex hormones, an oestrogen and a progestagen. These are currently produced synthetically from plants and have other uses, such as the treatment of menopausal syndromes, and the prevention of swelling of breasts and milk production when a mother does not breastfeed her newborn baby. Other steroid sex hormones are the male sex hormones, chiefly testosterone. Administration of testosterone is often required when natural development of male characteristics does not occur, in animals or humans.

CHOLESTEROL

Cholesterol makes up about 15% of the dry weight of the brain and nerve tissue, and is present in many other parts of the body. The spinal cord contains considerable amounts of cholesterol and gall stones are almost pure cholesterol.

Cholesterol is currently used in the synthesis of vitamin D_3. Its use as a raw material for the synthesis of steroid pharmaceuticals has been limited because of the difficulties in modifying it chemically. However, as technical improvements now allow the degradation of cholesterol by bacteria, thus greatly increasing the yields of the more valuable steroids, the demand for cholesterol should increase. The Japanese are in the process of building a factory which will use cholesterol from wool grease and fish oil as the raw material for bacterial and chemical production of oral contraceptives, while a large U.S. drug company is planning to use the closely related plant steroid, stigmasterol, for production of oral contraceptives.

The white matter of cattle spinal cord is used as a raw material for the extraction of cholesterol. The spinal cord is extracted with a solvent which enables excess water to be distilled off at the same time as the extraction is taking place. The crude cholesterol extract is then boiled in alcoholic sodium

hydroxide, allowing ionic impurities to be absorbed on to an ion exchange resin. Pure cholesterol is obtained in a yield of 3% based on the tissue weight.

BILE ACIDS

The gall bladder contains a complex solution of conjugated bile acids, bile pigments, fatty acids, phospholipids, protein, cholesterol and several other minor components. About 70% of the solids of the bile of cattle, sheep and goats is cholic and deoxycholic acid, two bile acids which are used as raw materials in the synthesis of corticosteroids. Corticosteroids are used in the treatment of inflammatory diseases such as arthritis and bronchial asthma. The oxidized product of cholic acid, dehydrocholic acid, stimulates the bile flow and use is made of this function in the treatment of indigestion, constipation, and bile tract disorders resulting from disease or surgery. The principal bile acid of pig gall, hyodeoxycholic acid, has only limited commercial use at present.

Usually, after separation from the bladder, the raw gall is concentrated to about 75% solids, a concentration at which it is stable. If gall is not concentrated, it must be preserved chemically, or frozen, within 24 hours to prevent bacterial degradation of the bile acids.

The processing of gall consists of heating with sodium hydroxide to remove amino acids combined with the bile acids, followed by precipitation of the mixture of cholic and deoxycholic acids from solution. The two acids are then separated, utilising their different solubilities in weak base, and purified. Some processors treat the crude mixture to convert the cholic acid to the deoxycholic acid, which is then the only product isolated.

Pure cholic and deoxycholic acids are not produced in Australia but there is at least one plant producing the crude bile acids mixture from the 75% solids.

HORMONES

Many hormones are secreted by various glands in the mammalian body but only a few are extracted from animal tissues in commercially significant amounts.

INSULIN

The importance of insulin in the treatment of diabetes is widely known. Insulin is extracted from the pancreas gland and the pancreas is likely to remain the only source of insulin for many years as it is an extremely difficult molecule to synthesize.

The pancreas glands of pigs and cattle are used as the main sources of insulin, although insulins from other species have been used in special cases. Pancreas glands of sheep contain only one third the concentration of insulin found in bovine pancreas glands and have not been utilized as an insulin source.

The method used has an important bearing on the insulin yield. It is important to ensure the entire tail of the gland is obtained, since this contains a greater concentration of insulin than the rest. Quick freezing of the gland is vital to avoid losses.

Most production methods are based on acidified alcoholic extraction of the minced pancreas followed by concentration of the extract at temperatures below 40°C. The crude insulin is salted out after removal of fat from the concentrate and then purified.

Glucagon is also obtained from the pancreas gland. It raises blood sugar levels and helps counteract insulin shock resulting from an overdose of insulin. It is also effective in treating low blood sugar episodes associated with alcoholism, and has a specialized use in the treatment of some psychiatric disorders.

PITUITARY HORMONES

The pituitary is a very small gland (2.5g/ox) situated at the base of the brain. The function of the pituitary gland is the secretion of a number of vital hormones.

The anterior lobe of the pituitary secretes the hormones adrenocorticotropin (ACTH), melanotropin, lipotropin, growth hormone, prolactin, thyrotropin, luteinizing hormone and follicle stimulating hormone. Each of these hormones has a precise regulating function in the body. ACTH is the main one extracted for commercial use, but synthetic forms of this are now being produced, and these are likely to replace completely the naturally-extracted hormone in pharmaceutical use.

ACTH stimulates the secretion of steroid hormones from the adrenal cortex. Its most important medical use is in restoring the activity of malfunctioning adrenal glands in humans. It can also be used in the treatment of rheumatic disorders such as arthritis, and eye inflammation due to allergies, as well as in the control of severe allergic reactions such as bronchial asthma. The pituitary glands from 10,000 cattle are required for the production of one pound of this valuable pharmaceutical.

Thyrotropin (THS) is a hormone that stimulates the thyroid gland to produce the thyroid hormone. It has been found especially useful in combination with radioactive iodine to locate small bits of thyroid cancer that have spread to other parts of the body. It is used for the diagnosis of hypothyroidism caused by an anterior pituitary failure or by complete failure of the thyroid gland (in the event of anterior pituitary failure, the

The posterior lobe of the pituitary secretes the hormones vasopressin and oxytocin. *Vasopressin* is used to control cases of excessive urination and in the testing of renal function. It is also employed to stimulate proper movement of material through the intestinal tract after surgery, and to dispel "gas shadows" when making abdominal x-rays. *Oxytocin* causes contractions of the uterus during labour and acts as the "let down" factor in lactation in humans and other mammals. Posterior pituitary extracts are also used to treat *diabetes insipidus*, in which the patient passes very excessive quantities of sugar-free urine. Vasopressin and oxytocin have been replaced by synthetics.

The gland is collected, trimmed and quick frozen after slaughter and maintained at -30°C until processed. The continued use of bovine pituitaries depends on a continued supply at a cost which is lower than that of the synthetic materials.

ADRENAL GLANDS (Suprarenal Glands)

Adrenaline (Epinephrine) - This drug is used to relieve some of the symptoms of hay fever, asthma, and some forms of allergies affecting the mucous membrane of the nasal passages. It is also used to stimulate the heart under certain crisis conditions and in dental practice to prolong the effects of local anaesthetics. Adrenal cortex extract was used for treating Addison's disease, and in surgery to overcome shock. Adrenaline is now almost totally obtained from synthetic sources.

PARATHYROID GLANDS

In certain clinical conditions the human parathyroid gland cannot produce enough of the principal hormone it secretes, and the bovine parathyroid hormone can be used to compensate for this. Without it, parathyroid deficiency can develop and result in convulsions, painful muscular spasms, loss of calcium from the bones, abnormal tooth development, and cataracts. Parathyroid hormone requirements are partially met by synthetics.

THYROID GLAND

Thyroid extract from pork and beef, and administered in tablet form, plays a major role in the treatment of conditions where there is an absence or shortage of thyroid hormone. Some synthesis of the active ingredients is also carried out.

PINEAL GLAND

Pineal glands are used for the production of pharmaceuticals used in treating schizophrenia and are now being tested as sources of possible stimulants for the mental and physical development of some retarded children.

SEMINAL VESICLES

The seminal vesicles situated on the bladder in male animals are a source of *prostaglandins*. The first clinical use of prostaglandin was to induce parturition and it is now used routinely in childbirth in many United Kingdom hospitals. In larger doses it has been used to induce abortion. Prostaglandins have also been found to be effective in healing gastric ulcers and relaxing respiratory smooth muscle in bronchial asthma sufferers. In addition, these compounds have been used in the synchronisation of oestrus in cattle, horses and pigs, a technique of considerable commercial importance for artificial insemination, stud breeding and the prevention of haphazard farrowing. A further application has been discovered in the treatment of people who have problems with thrombosis and high blood pressure. However, it is likely that synthetic materials will displace the natural material in the near future.

ENZYMES

RENNET

Rennet is an enzyme preparation of the fourth stomach of calves, called the vell (abomasum). It mainly contains the proteolytic enzyme rennin, which has the property of curdling milk. Rennet is used in cheese making, in the preparation of junket, and to help infants digest milk. It is the only enzyme economically produced from animal tissue on a regular commercial basis.

PANCREATIN

Besides being the source of insulin, the pancreas is also used for the preparation of an enzyme preparation called pancreatin, which forms the basis of pharmaceutical preparations prescribed for pancreatic insufficiency.

Pancreatin contains enzymes which will digest proteins (proteases), starches (amylase) and fats (lipase). The pig pancreas is the preferred raw material as it yields a pancreatin having high protease, lipase, and amylase activity.

Pancreatin cannot be readily obtained because the major use of the pancreas is in insulin production. The waste residue has lost the lipase and amylase activities, precluding its use for pancreatin production.

Specific enzyme preparations containing the pancreatic enzymes trypsin, chymotrypsin, ribonuclease and deoxyribonuclease are sometimes required.

Chymotrypsin is an enzyme used to cleanse wounds and to remove dead tissue where ulcers and infections occur. It can be used in treating serious injury or following surgery when localized inflammation and swelling result due to excess fluids.

Trypsin can digest dead tissue without significantly affecting live tissue and is therefore ideal for cleansing wounds in certain situations.

PEPSIN

Pepsin is a proteolytic enzyme obtained from the lining of hog stomachs and is active in acid media only. It is used clinically when there is insufficient secreted by the stomach to control the degradation of proteins into proteoses and peptones.

HYALURONIDASE

Hyaluronidase enzyme from bull testes infiltrates the gel surrounding all body cells, aiding in the rapid and even diffusion of administered fluids.

ANTICOAGULANTS

HEPARIN

Heparin is a complex mixture of mucopolysaccharides with the property of prolonging the clotting time of blood (anti-coagulant). It is used to prevent blood coagulation during operations and to prevent the formation of blood clots within the circulatory system which, in certain clinical situations, could lead to a heart attack or stroke. Heparin is also used to reduce the risk of gangrene in cases of frostbite and as a burn treatment. It is present in the mast cells of connective tissue, from where it is released after injury.

Heparin is injected as a solution of the free substance or as the sodium or calcium salt and takes effect immediately, whereas the alternative oral anti-coagulants may take several days to become effective.

Lungs and gut mucosa are the raw materials used for heparin extraction, and pig and beef mucosa are the preferred sources owing to the high yield of heparin obtainable. The mucosa is collected during the machining of the casings and is either preserved in a raw state or processed into a dry form before shipping to the heparin manufacturer.

OTHER PHARMACEUTICALS

FROM BLOOD

Thrombin helps create significant blood coagulation. It is valuable in the treatment of wounds, particularly in cases where the injury is in an inaccessible part of the body such as the brain, bones, or gastrointestinal tract (as in the case of peptic ulcers). Thrombin is also used in skin grafting to help keep the graft in place and to "cement" gaps where tissues have been surgically removed.

Fibrinolysin is combined with deoxyribonuclease from the pancreas to aid in the removal of dead tissue that results from certain vaginal infections. It is a valuable cleansing agent for infected wounds or clotted blood and can speed the healing of skin damaged by ulcers or burns.

FROM LIVER

Liver extract is sometimes combined with folic acid and injected into the blood stream for the treatment of various types of anemia including pernicious anemia. Liver extract injections are now also used to treat sprue, a long term condition associated with diarrhea, weakness, emaciation, and anemia.

FROM SPLEEN

Spleens are a source of pharmaceuticals used in the treatment of certain blood and lymph diseases.

FROM THE DUODENUM

Dessicated duodenum is used for the extraction of an intrinsic factor which aids the absorption of vitamin B_{12} by pernicious anemia patients.

FROM GALLSTONES

These are considered by some countries to have aphrodisiac properties.

YIELDS

Average yields of the more important glands and tissues used for pharmaceutical production are listed in the following table:

RAW MATERIAL	NO. OF GLANDS PER ANIMAL	BOVINE	OVINE	PORCINE
PANCREAS	1	250-400g	30g	50-130g
PITUITARY	1	2.0-3.0g	Sheep 0.8g Lamb 0.5g	0.4-0.8g
PINEAL	1	0.3g	0.04-0.12g	0.1g
ADRENAL	2	15-30g	2-3g	3-5g
THYROID	1	25-30g	3-9g	5-10g
PARATHYROID	2-4	0.5g	0.2g	0.15g
OVARY	2	10-20g	1.5g	5.0g
TESTES	2	500-1000g	100g	150g
SPLEEN	1	500-900g	Sheep 90g Lamb 55g	90-150g
SPINAL CORD	1	100-150g	40g	50g
GALL (FRESH)	1 bladder	300-400g (9% solids) Calf 10-15g (8% solids)	Sheep 25-30g (11% solids) Lamb 15-20g (12% solids)	
VELLS	1	390g green 20g dry		
RAW BLOOD		4% of carcass weight	7% of carcass weight	

These figures are approximate only, and Processors should check their own.

Many pharmaceuticals can be synthesized less expensively than they can be produced from animal sources. For some pharmaceuticals, synthesis is only partial and animal sources remain extremely important. For example, the protein drugs (e.g. insulin and some pituitary hormones) are so complex that commercial technology for attempting their synthesis is not available.

Studies have shown that plants do not have to be large to make collection a worthwhile proposition. Even though the glands and total amount collected may be small, the unit price is considerably higher than that received for conventional meat products and worth some hundred times more to a producer than they would be worth as meat scraps.

The question that should be exercising the minds of commercial people in Australia is, "Which of the pharmaceuticals and other fine chemical end products can be produced economically in Australia?" Currently it seems that there is most scope for the production of steroid hormones from gall and spinal cords, and heparin from mucosa and lungs.

ACKNOWLEDGMENTS

Source material used extensively in this Newsletter included, "Recovery of Fine Chemicals from Animal Tissue," by Dr. R.P. Garland, New Zealand Pharmaceuticals Ltd, presented at the Eighteenth Meat Industry Research Conference at Rotorua in 1976, and "The Pharmaceutical Industry," by Dr. G.T. Klease, presented at the Resources and Waste Management Seminar in Sydney during 1976. We also thank the Commonwealth Serum Laboratories for their advice.

ABSTRACTS

Below are some abstracts of recent publications which may be of interest. Copies of publications are restricted to the Australian meat processing industry and can be obtained by completing the attached form. Alternatively, in the case of articles published in *Food Technology*, readers may obtain reprints directly from the author(s), the address(es) of whom are supplied. If the attached form is used, payment must be made in advance.

"SOLAR-ENERGY COOLING AND FREEZING OF FOOD: A COMPUTER ANALYSIS," by John M. Krochta & Thomas R. Rumsey, *Food Technology*, March 1977, 7p.

Performing an energy analysis on any process can and should involve several steps. These include: (1) determination of the overall energy consumption of the process, with a breakdown of consumption into individual steps and individual products; (2) defining the basic principles involved in the process steps in order to calculate the theoretical energy demand and thus the operating energy efficiency; (3) using the basic principles to suggest process modifications within the context of the process principles; (4) consideration of alternate processes involving completely different principles; and (5) assessment of alternate process energy sources to ensure use of a balance of the least expensive, most reliable alternative.

This paper focuses on the last of these steps for the cooling and freezing of foods. The concern for safe, inexpensive energy sources which will be available for the foreseeable future has led to an analysis of the use of solar energy for these processes. Considering the importance of a reliable food supply, it seems reasonable that all potential energy sources be considered. Certainly, a considerable amount of encouragement from both the private and public sectors has been voiced in this regard (Krochta *et al*, 1975).

The authors are, respectively, Research Chemical Engineer and Research Mechanical Engineer, Western Regional Research Center, Agricultural Research Service, U.S. Department of Agriculture, Berkeley, CA 94710.

"PERFORMANCE OF CARCASS BLAST FREEZERS," by J.M. Marer, *International Institute of Refrigeration, Australian National Committee*, Paper No.8 (6-10 September 1976), 8p.

Performance or efficiency of freezing depends on a complexity of variables such as rate of loading, spacing of carcasses on the rails, temperature of carcass at time of loading into the freezer, weight range of carcass being frozen, to name but a few.

It is acknowledged that design affects performance and there is a number of factors which must be considered if desired results are to be achieved. However, the one factor that is often discounted is management.

Management is the greatest single factor that can either make or break the performance of a freezer for, despite a designer's allowance for extreme conditions, there are occasions when freezers are hard pressed to cope with carcasses they contain. This condition may be attributed to freezer mismanagement. While instruction is no doubt given to those in charge it is seldom followed up to see that the

"FROZEN COOKED MEAT ANTIOXIDANT: IMPROVED ACTION OF SODIUM TRIPOLYPHOSPHATE WITH LEMON JUICE CONCENTRATE," by L.W. Haymon, E. Brotsky, W.E. Danner, C.W. Everson & P.A. Hammes, *Journal of Food Science 41*, No.2, March-April 1976, 4p.

Enhanced antioxidant action was observed for the combination of sodium tripolyphosphate (STP) and lemon juice concentrate (LJC) in frozen meat products. The STP/LJC antioxidant was evaluated in beef products (patties, steak and meat loaf) and soy extended products which were cooked, then frozen. Storage trials of the precooked frozen meat products were conducted with unrestricted oxygen at -18°C. All of the products were reheated from the frozen state with microwave ovens. The reheated cooked products made with STP/LJC antioxidant were statistically preferred to other antioxidant treatments and controls as judged by expert taste panels. The antioxidant activity was monitored by expert flavor panels and thiobarbituric acid number (TBA). The sodium tripolyphosphate and lemon juice concentrate have been made into a dry free-flowing food ingredient for use in the meat industry (U.S. Patent 3,875,313, April 1, 1975).

Authors' Abstract

"FURTHER EVALUATION OF CONVENTIONAL AND HOT-BONED BOVINE *LONGISSIMUS DORSI* MUSCLE EXCISED AT VARIOUS CONDITIONING PERIODS," by C.L. Kastner, D.P. Sullivan, M. Ayaz & T.S. Russel, *Journal of Food Science 41*, 1 (January-February 1976), 3p.

The objective of this study was to evaluate the tenderness of bovine *longissimus dorsi* muscles conditioned in the intact half at 16°C and excised at 6, 8 or 10 hr postmortem (hot boning) as compared to the same muscles chilled at 2°C and excised at 48 hr postmortem (cold boning). Fifteen choice and good grade heifers were utilized in this study. When each postmortem holding period was evaluated, statistically nonsignificant differences ($P > 0.10$) were observed between hot- and cold-boning means for shear force, myofibrillar protein extractability and sarcomere length. A statistically significant difference ($P < 0.10$) between hot- and cold-boning fiber diameter means was observed at the 6-hr holding period. Fiber kinkiness means for the hot-and cold-boning treatments were also statistically different at the 6- ($P < 0.01$) and 8-hr ($P < 0.10$) holding periods. These data indicate that conditioning intact halves at 16°C and excising bovine *longissimus dorsi* muscles at 8-hr postmortem can yield a product of acceptable tenderness. The authors recommend the 8-hr holding period as a precautionary measure realizing that the 6-hr holding period did not give greatly different results.

Authors' Abstract

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Meat Research News Letter

CSIRO Division of Food Research
Meat Research Laboratory

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P.O. Box 12, CANNON HILL, BRISBANE, QLD. 4170
(CNR. CREEK & WYNNUM ROADS)
Telephone 399 3122. Telex 40150.

Date 30th December 1977 **Number** 77/6

SHEEP & LAMBSKIN QUALITY IMPROVEMENT*

Sheepskins are a valuable Australian resource. From 1970 to 1975 the average annual value of sheepskin exports was $72 million, and in 1976/77 the value was $110 million. One objective of the Hide & Skin Improvement Programme planned by the CSIRO Leather Research Group is to improve the quality, and therefore the value, of Australian sheepskins.

A sheepskin is worth, on average, over 30% of the value of the live animal. It should therefore be considered an important part of the sheep and not just a byproduct of the meat industry. Skins are damaged during the life of the sheep, during flaying, and during preservation, storage and transport.

*This Newsletter has been prepared by:

Mrs. C.A. Money
Leather Research Group
CSIRO Division of Protein Chemistry
Parkville, Victoria

1. Damage Occurring During Life

(a) *Seed & Burr*

Grass seeds work into the skin and leave holes or scar tissue, which reduce the value of the skin. CSIRO Meat Research Newsletter No.76/4 describes the grass seed problem and ways in which grass seed infestation can be reduced.

Burrs in wool are difficult to remove and often cause machine damage to the skin during tanning.

(b) *Shearing & Other Damage*

Unevenly shorn wool reduces the value of skins. Cuts and scratches leave scar tissue, and disease and insect infestations can affect the skin.

2. Damage Occurring During Skin Removal

Cuts and flay marks made during skin removal are responsible for serious reductions in quality. Skins are sorted into "sounds," "seconds" and "cuts," and the following guidelines are used:

"Sound" - No cuts, or cut can be trimmed without disturbing the pattern.

"Second" - Bad flay marks, or a cut less than 13 cm (a hand's breadth) from the edge of the skin.

"Cut" - A cut more than 13 cm from the edge or several cuts nearer the edge.

A skin with a cut is worth about a dollar less than a sound skin. As 50% of skins produced at a meatworks are often classified as "seconds" or "cuts," the losses, based on an export market of $72 million, could be $12 million. Cuts reduce the value of the resultant leather, make the skins unusable as sheepskin rugs, and often cause the skin to tear during tanning. Flay marks are less obvious than cuts but result in very thin, weak areas.

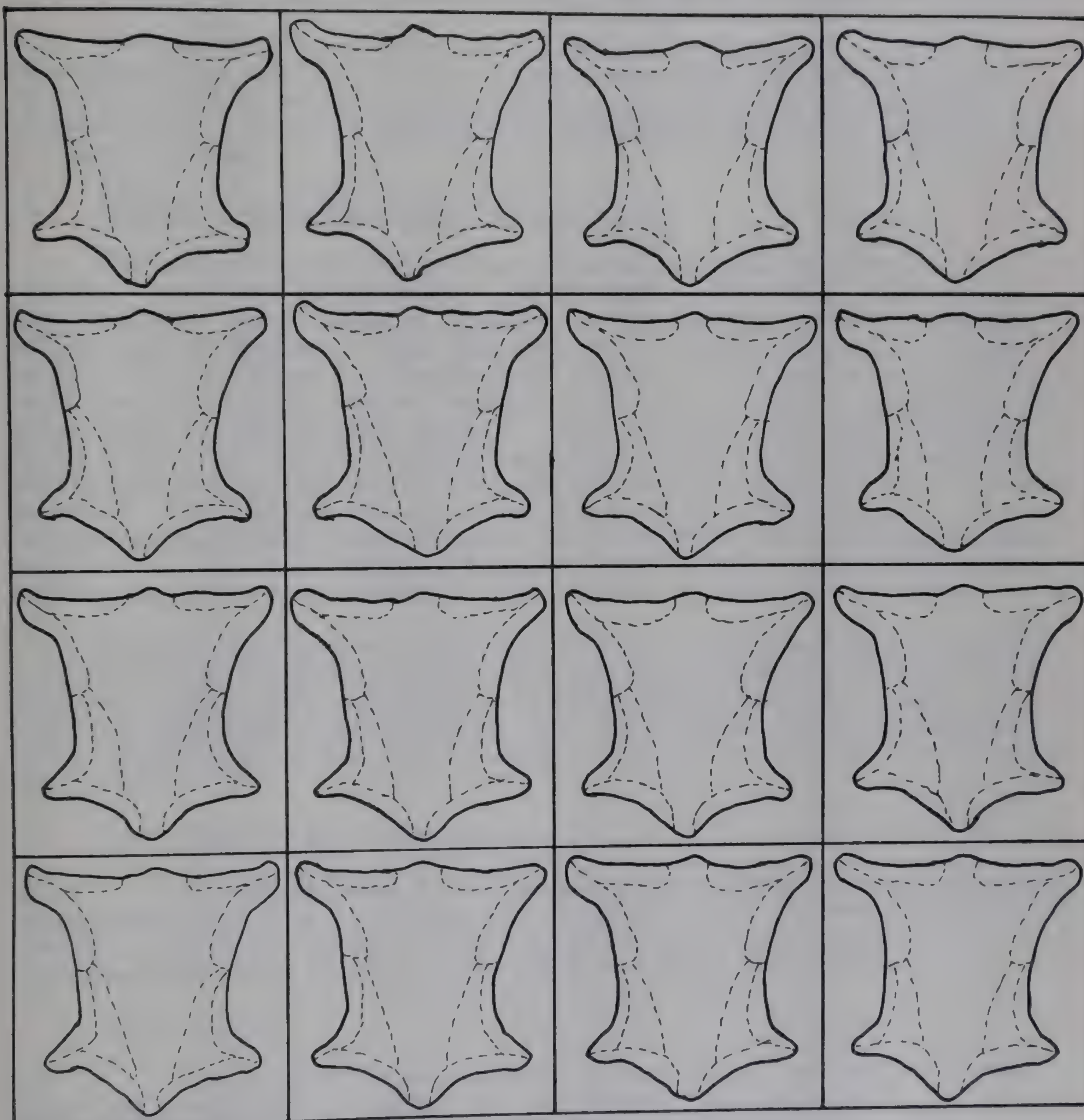
Some works have already introduced quality control programmes to reduce knife damage to skins, and an example of a chart used for this purpose is given in Fig.1. Several times a day the skins coming from the chain are examined for cuts and one of the 16 skin diagrams on the chart is used to record the position of damage for each skin. The system can also be used to record skin substance and seed damage. With the use of diplomacy and such charts to isolate where the damage occurs, the amount of damage can be considerably reduced.

FIG.1

SHEEP & LAMB SKIN INSPECTION

Date ....   Chain No. ....

Sheep & Lamb Kill ....   No. Skins Inspected ....



SUMMARY

No. Cuts in: Legs .... Flanks .... Briskets ....

Butts .... Shoulders .... Necks ....

No. "Cut" Skins .... No. "Second" Skins ....

Key: 1. Lgt Sub.; 2. Med. Sub.; 3. Hvy Sub.; 4. Vry Lgt Seed; 5. Lgt Seed; 6. Seedy; 7. Hvy Seed; 8. Vry Hvy Seed; 9. Hvy Fat & Body Tissue.

....

Another system similar to the one being introduced for hide cuts would be to use one larger diagram of a sheepskin per lot of skins and mark the position of each cut on the diagram (Fig.2).

The pattern of a skin is important to tanners, and is determined by the initial cut made when the carcass is opened. This cut should be down the centre line, so that the skin is symmetrical. This is especially important for skins which are to be used as rugs.

3. Damage Associated with Preservation

The majority of Australian sheepskins are air-dried in sheds. Some are dried under controlled conditions, and others are salted. Many tanners prefer a well-salted skin to a dried skin, but at Mazamet, the destination of more than half of our skins, dried skins are preferred. This is because salted skins must be thoroughly washed before they can be fellmongered by the sweating, or bacterial, method. In addition, the salt removed from skins during processing can lead to effluent problems. A small proportion of woolskins are processed "green," i.e. tanned without first being dried or salted, and some skins are fellmongered green and the pelt is preserved by pickling in salt and acid. All the methods require care because skins which are inadequately dried or salted are easily damaged by bacteria.

Any delays before treatment should be minimal and the skins should be kept in the shade. A pile of sheepskins retains heat and provides ideal conditions for bacterial growth. When salting, because drying out of the flesh side prevents adequate salt penetration, the skins should be stacked with the wool side up.

(a) *Short Term Preservation*

If skins have to be transported "green," they should be preserved with the chilling and chemical methods developed by the Leather Research Group. These methods give good results and information about them can be obtained from the Group.

(b) *Drying*

The conventional method of air-drying skins in sheds uses solar and wind energy but is labour intensive and unpredictable because it is dependent on the weather. The unpredictability increases the likelihood of damage occurring to the skins. The damage can be due to underdrying, resulting in heating, sweating and mould, or overdrying, resulting in cracking of the skins. Melted and oxidized grease is also a problem. Skins are considered dry when they contain 15-20% moisture. The legislation which prevents the removal of ears before drying is currently being reviewed because ears also cause drying problems.

FIG.2

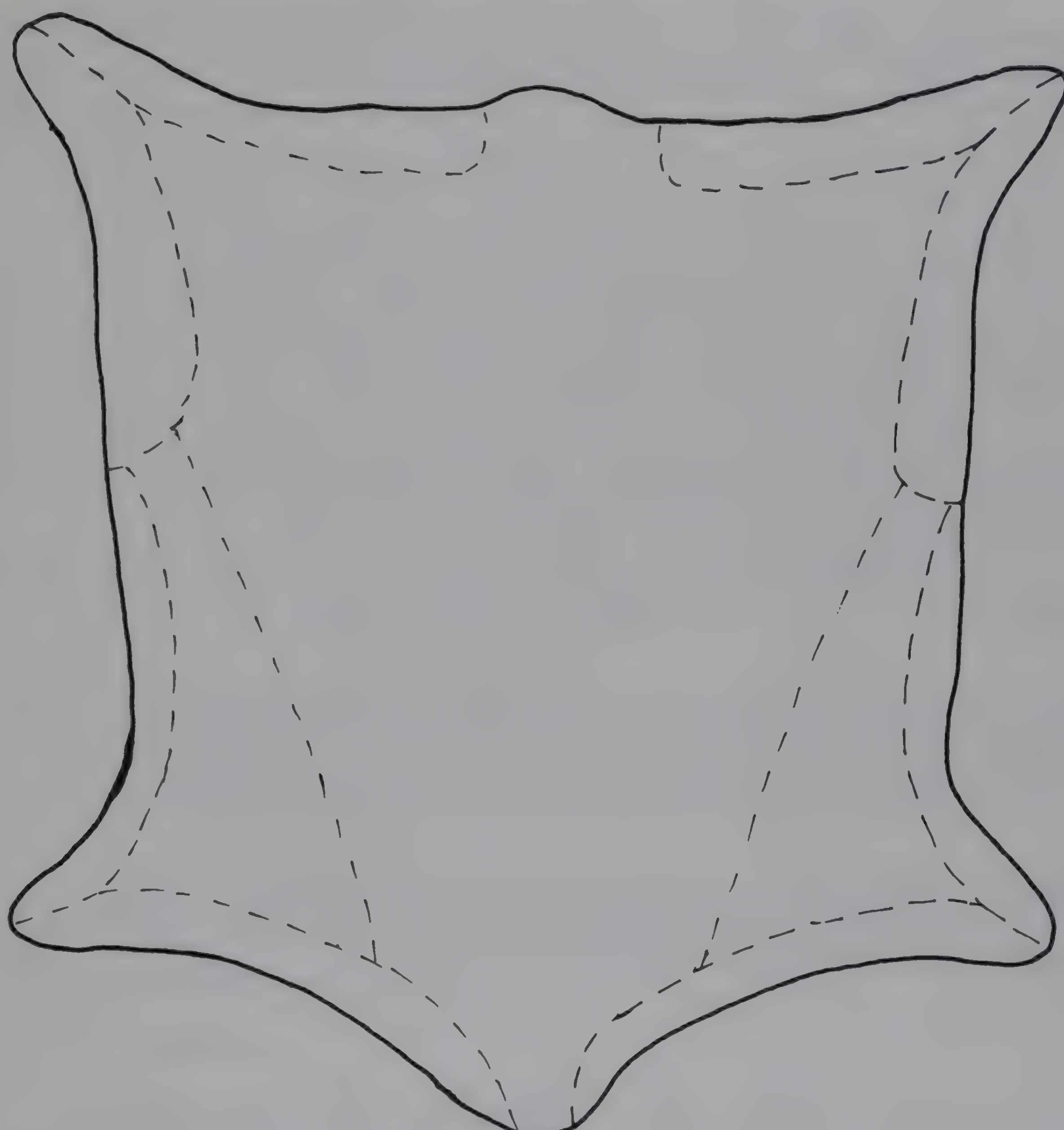
SHEEP & LAMB SKIN INSPECTION

Date ....

Chain No. ....

Sheep & Lamb Kill ....

No. Skins Inspected ....



SUMMARY

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No. "Cut" Skins: .... No. "Second" Skins: ....

Key: 1. Lgt Sub.; 2. Med. Sub.; 3. Hvy Sub.; 4. Vry Lgt Seed; 5. Lgt Seed; 6. Seedy; 7. Hvy Seed; 8. Vry Hvy Seed; 9. Hvy Fat & Body Tissue.

Inspected by: ....

Often, especially in winter, the climate is not suitable for air-drying in sheds, and forced drying must be used to "finish off" the skins.

Information has been published on the design and operating costs for an air-conditioned enclosure for the controlled drying of sheepskins. The system involves two 24-hour cycles, with controlled humidity during the second 24 hours. A drying cycle whereby ambient air is continuously heated to 29°C and passed over the skins at velocities of 0.25-0.6 mps for the first 24 hours of the cycle is proposed. There would be no recirculation of this air in the ideal case, and the relative humidity in the drying zone would be kept to the minimum permitted by the external conditions, in order to achieve high rates of drying in this period. The second phase of the drying, again of 24 hours' duration, requires full recirculation of air with relative humidity maintained at 50-55%. This is basically an equilibration period where skins are brought to a commercially acceptable moisture content for packaging. Provided the two main conditions (i.e. that a temperature of 29°C is never exceeded, and that the relative humidity at the final stage of equilibration is in the range 50-55%) are adhered to, many variations of the method are possible.

Several drying enclosures are now operating in Australia, but most processors use a system similar to the first 24-hour cycle where humidity is not controlled and skins are hung in sheds to equilibrate. This method improves the drying rate but it is not controlled drying.

To prevent damage due to infestation with weevil (*Dermestes* beetle), skins are sprayed with insecticide, preferably before drying. Sodium arsenite is most commonly used but its toxicity presents some safety problems.

(c) *Salting*

Although sheepskins have been salted in other countries for many years it is a relatively new method in Australia. There is a demand for well-salted skins, and drum salting can be cheaper than drying.

In the last few years sheepskins salted in Australia have sometimes been severely damaged and poor cure has been traced to very low levels of additives in commercial salt. Salt additives *are essential* for sheepskin curing, and various additives are compared in Table 1.

Wooden tannery drums, concrete mixers and butter churns are all used for drum salting, and times and speeds of rotation vary. A good cure can be achieved when skins are drummed for one hour at 16 rpm with 25% salt, plus additives, based on skin

weight. In Australia sheepskins are not usually washed before salting and no brine effluent is produced. If the skins were washed, more salt would be required to saturate all the moisture present.

The 10 treatments listed in Table 1 were compared to determine which additives give satisfactory preservation and whether it is worth the additional expense to use stoved (heat sterilized) salt.

TABLE 1

Comparison of Additives for Sheepskin Salting

Unstoved salt was used in Treatments 1-9, and stoved salt in 10; 25 skins were salted in Treatments 1-3, and 50 in Treatments 4-10. Average skin weight was 4.2 kg. Wool length was within the range 0.5-2 inches.

	Percentage of Additive in Salt	After 17 months' Storage Damage*	After 17 months' Storage Yellowing†
1.	1% sodium fluoride	2	1
2.	1% boric acid	4	0
3.	1% naphthalene, 1% boric acid	0	3
4.	1% sodium metabisulphite, 1% boric acid	3	2
5.	1% sodium metabisulphite, 1% sodium fluoride	1	3
6.	1% colloidal zinc oxide, 1% boric acid	1	2
7.	1% colloidal zinc oxide, 1% sodium fluoride	0	4
8.	2% zinc sulphate.$7H_2O$, 1% sodium fluoride	0	2
9.	1% zinc chloride, 1% sodium fluoride	0	2
10.	1% sodium metabisulphite, 1% boric acid - stoved salt	1	1

*0 - no damage
1 - 10% skins damaged
2 - 30% skins damaged
3 - 40% " "
4 - 60% " "

Damage consisted of bald patches, grain separation and grain damage.

†In the grading system of 0-4, 0 indicates no discolouration and 4 represents considerable yellowing.

Cost of Treatments 1 & 2 is less than 3-9, which are less than 10.

Any of the additives at the indicated levels can successfully preserve drum-salted sheepskins at moderate temperatures and humidities for eight months. Heat sterilized salt is not necessary for good preservation.

The following additives gave the best preservation for storage periods of 8-17 months:

(a) 2% zinc sulphate.$7H_2O$ plus 1% sodium fluoride

(b) 1% zinc chloride plus 1% sodium fluoride

(c) 1% naphthalene plus 1% boric acid

(d) 1% zinc oxide plus 1% sodium fluoride

Each of the four treatments caused some discolouration of the wool. The last two treatments cannot be recommended because of the unsatisfactory degree of discolouration. It is interesting that the naphthalene did not cause the pink discolouration often reported but did cause yellowing.

NB:

1. Sodium fluoride is not an effective additive for salts with high magnesium or calcium contents because the insoluble fluorides are precipitated.

2. Salted sheepskins are more susceptible to degradation than hides and the length of time that well-salted skins can be held depends on the storage temperatures and humidities. In this trial the skins were stacked on pallets, covered with plastic, and stored under moderate conditions. For storage at higher temperatures and humidities the recommended methods may not be satisfactory if the hides are to be stored for 17 months.

Summary

Unnecessary loss in value occurs during the removal and preservation of sheepskins. There is a great need for quality control and for further research work, and several projects are planned.

ABSTRACTS

Below are some abstracts of recent publications which may be of interest. Copies of publications are restricted to the Australian meat processing industry and can be obtained by completing the attached form. Payment must be made in advance.

"THE FROZEN FOOD CABINET - THE USER'S VIEWPOINT," by Owen L. Clark, *Australian Refrigeration, Air Conditioning and Heating*, November 1977, 4p.

In recent years the effectiveness of the frozen food retail cabinet as a cold storage unit has been questioned. Whether or not this questioning is justified, the cabinet has been the centre and subject of many debates at both industry and scientific level.

The object of this paper is to query the justification of questioning the frozen food cabinet's effectiveness as a food storage unit in a supermarket environment. The retailing of frozen foods is not a new industry but one which has been with us for many years, operating with a relatively high degree of efficiency.

"THE FROZEN FOOD RETAIL CABINET - THE MANUFACTURERS' VIEW," by H.G. Goldstein, *Australian Refrigeration, Air Conditioning and Heating*, November 1977, 4p.

In endeavouring to present the manufacturer's view of frozen food cabinets, this talk does not necessarily and in all details claim to represent the views of C.R.M.A.

Placing this talk between those representing the viewpoints of the food technologist and the user, i.e. the store operator, the organisers of this symposium have correctly presented the position of the manufacturer as the meat in the sandwich between the sometimes rather perfectionist requirements of our research friends and the practical demands of our valued customers. Of course, for the manufacturer the customer is king, and the food technologist's or anyone else's views affect him only as far as and to the degree that they are accepted by the user - or are enforced by law.

"PROPOSED FROZEN FOOD LAWS," by R.A. Edwards, *Australian Refrigeration, Air Conditioning and Heating*, November 1977, 2p.

There are at present no specific regulations covering the handling, distribution and retailing of frozen foods in Australia. This means that manufacturers, distributors and retailers who handle frozen foods, do so in a way which varies from the disastrous to the acceptable.

This situation is not peculiar to Australia. It is common throughout those countries in the world where the emergence and growth of the frozen food industry has been one of the most spectacular developments in food marketing in the past 30 or so years.

Some 20 years ago the U.S.A. frozen food industry produced a voluntary code of practice for the efficient and proper handling of frozen products to ensure retention of product quality, by maintaining a product temperature of -18°C throughout the entire chain of production, distribution, warehousing, storage and

"THE TECHNOLOGY AND MARKETING OF SEMI-MOIST PET FOODS," by R.J. Inwood, *Food Technology in New Zealand*, November 1977, 6p.

The market for pet foods in the United States is four times that for baby food, and sales are equal to those for washing powder. New formulas include the development of semi-moist techniques which, in the case of dog food, enhances the resemblance of the product to the traditional meats. This article is based on a paper which was delivered by the author in May at Massey University.

"HOT BONING OF BEEF CARCASES," by A. Cuthbertson, *The Institute of Meat Bulletin*, Number Ninety-Seven, August 1977, 6p.

There is increasing interest in Britain in hot boning of beef carcases. The hot boning procedure is in marked contrast to traditional practice throughout most of the world where it is usual for the dressed beef carcase to be cooled for 18 hours or more before it is cut. As the temperature of the meat drops, both lean and fat become firmer and, when cut with a knife or saw, the cut surfaces remain neat. Chilled sides of beef handled in this traditional manner are commonly first quartered in the abattoir and then broken into primal cuts in the shop by sawing through bones and cutting through the muscles. There is also, however, a good deal of trade in bone-in primal cuts.

In recent years, a number of meat firms have been developing variations of this standard procedure. One of these is to cut, debone and trim fat off chilled sides of beef at the abattoir followed by vacuum packing these trimmed deboned primal cuts for distribution to retailers. Another is to remove the meat from the bones of the whole chilled side as it hangs without first breaking it down into bone-in primals.

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